

ES10L / ES10XL/ Fx-ES10
Optical CATV Transmitter 1550 nm

Operating Manual

Safety instructions

Attention:

**Please read the instructions completely and carefully
before putting the transmitter into operation!**

**All operation steps should be carried out in the
prescribed sequence!**

**Improper putting into operation can cause serious
danger for persons or can damage the devices.**

**INVISIBLE LASER RADIATION
DO NOT STARE INTO BEAM OR
VIEW DIRECTLY WITH OPTICAL
INSTRUMENTS**

CLASS 1M LASER PRODUCT

**MAXIMUM OUTPUT POWER:
20.0 mW**

WAVELENGTH: 1550 nm

IEC 60825-1:2007

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All products manufactured by BKtel communications GmbH are guaranteed to be free from defect in material and workmanship for a period of two (2) years from the date of shipment. During the warranty period, BKtel communications GmbH will repair, or replace at its option, any product or parts thereof which have been sold by BKtel communications GmbH or authorized representatives to the Buyer, where such products or parts thereof, upon inspection by BKtel communications GmbH and in the sole opinion of BKtel communications GmbH are determined to be defective in workmanship or material. BKtel communications GmbH reserves the right to issue a credit note for any defective product or parts thereof, as determined by BKtel communications GmbH, as an alternative to the repair or replacement of such defective product or parts thereof. This warranty shall extend to all products and parts thereof which have been proved defective through normal use, but this warranty shall not cover any products or parts thereof that have been subjected to conditions exceeding the applicable specifications or ratings for such products or parts thereof, or such products or parts thereof which have been disassembled, modified or otherwise abused.

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TABLE OF CONTENTS

SAFETY INSTRUCTIONS	8
• General Safety Instructions	8
• Laser Safety Classification	9
1 TYPE INFORMATION	12
2 GENERAL DESCRIPTION	13
2.1 Introduction	13
2.2 Principle of Operation	14
2.3 Principle of Element Management	17
2.3.1 Webbrowser Communication	18
2.3.2 NMS Communication	19
3 TECHNICAL SPECIFICATIONS	20
3.1 ES10XL	20
3.2 ES10L	23
3.3 Fx-ES10XL	25
3.4 I/O Ports	26
3.4.1 ES10La/ES10XLa ((a-versions)	26
3.4.2 ES10Lb/ES10XLb (b-versions)	28
3.5 EMS / Service Interfaces	30
3.5.1 NMS server interface: Ethernet 10/100Mbps (a-versions only)	30
3.5.2 Local Management Terminal: USB interface (a-versions only)	30
3.5.3 BK device bus interface: RS485-master (a-versions only)	30
3.5.4 BK device bus interface: RS485-slave (b-versions only)	30
3.6 Front Panel	30
3.7 Rear Panel	31
3.8 Power Supply and Fan Modules	31
3.8.1 100 – 240 VAC module	32
3.8.2 ±48 VDC module	32
3.8.3 Fan-only module	33
3.9 Labeling	33
4 OPERATING THE ES10	34
4.1 Handling Optical Components	34
4.1.1 Handling Optical Fibers	34
4.1.2 Connecting and Disconnecting Optical Connectors	34
4.1.3 Cleaning Optical Connectors	34
4.2 Power-Up Sequence	38

4.3	Operating Conditions	38
4.3.1	Optical output signal	38
4.3.2	Applying an appropriate RF input signal	38
4.3.3	AGC Modes	40
4.3.4	Adjusting Regulation Mode	41
4.3.5	ITU Frequency Adjustments in DWDM Applications (XL only)	41
4.3.6	Optical Power On /Off	41
4.3.7	SBS suppression setting (XL only)	41
4.4	Push Button / LCD Display	43
4.5	LED Alarm and Warning Messages	45
5	CONTROLLING A NEC	48
5.1	Communicating with the NEC	49
5.2	Devices Update	51
5.3	Configure Slots (optionally)	52
5.4	Server Properties	53
5.5	Event Log	54
5.6	Statistics	55
5.7	General Purpose I/O Ports of NEC Server (Option)	56
5.7.1	Examples of I/O port status information	59
5.8	Server Administration	60
5.9	SNMP Configuration	60
5.10	Server Update	64
5.11	Config Save	65
5.12	Config Restore	67
6	CONTROLLING ES10 VIA A NEC	69
6.1	Status	69
6.2	Alarm and Warning Messages in the Status Page	70
6.3	Parameters	72
6.4	Internal Voltages	73
6.5	Settings Menu	74
6.5.1	Changing SBS Threshold	75
6.5.2	Changing SBS Fiber Type and SBS Fiber Length	76
6.5.3	Changing $O_{\text{M}}I_{\text{totrms}}$ (AGC on mode only)	77
6.5.4	Setting Gain (AGC off mode only)	78
6.5.5	Changing AGC Mode	79
6.5.6	Setting Slope	80
6.5.7	Changing ITU Laser Frequency	81
6.5.8	Changing Optical Output Power Mode	82
6.5.9	Changing Regulation Mode	83
6.5.10	Changing Redundancy Mode	84

6.5.11	Setting Redundancy Mask	87
6.5.12	Selecting a Redundancy Mask	88
6.5.13	Setting CATV Signal Channel Spacing	90
6.6	Limits Menus	91
6.7	Setting an Event Mask for Webserver and SNMP Interface	93
6.8	Properties Menu	94
7	CONTROLLING OTHER DEVICES WITH A NEC	96
8	MAINTENANCE	97
9	TROUBLESHOOTING	97
10	RELEASES	98
10.1	ES10 Hardware Releases	98
10.1.1	Hardware Releases for ES10La/ES10XLa	98
10.1.2	Hardware Releases for ES10Lb/ES10XLb	98
10.2	ES10 Software Releases	98
10.2.1	Application Software Releases for ES10La/ES10XLa	98
10.2.2	Application Software Releases for ES10Lb/ES10XLb	99
10.2.3	Bootloader Software Releases	99
10.3	Network Element Controller Releases for ES10La/ES10XLa	99
10.3.1	Hardware Releases for Embedded NEC	99
10.3.2	NEC Application Software Releases for Embedded NEC	99
10.3.3	NEC Bootloader Software Releases for Embedded NEC	100

DOCUMENT STATUS

Document Operating Manual ES10

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00	31.07.2008	Illies	Document created
01	01.10.2009	Illies	<ul style="list-style-type: none"> - NEC appl. SW release 3.0.0 - ES10 / ES26 appl. SW release 3.6 - CSO regulation mode revised - Gain adjustment range revised - Alarm & Warning Flags revised
02	02.08.2010	Illies	<ul style="list-style-type: none"> - NEC appl. SW release 3.0.5 - ES10 / ES26 appl. SW release 3.7 - Description of channel controlled mode updated - LED Display revised - Event log revised - New types with 12 dBm & 13 dBm output added
03	22.06.2011	Illies	<ul style="list-style-type: none"> - ES10 / ES26 appl. SW release 3.8 - ES10 / ES26 HW release 5.0 - NEC-E appl. SW release 3.1.3 - NEC-E Bootloader SW release 2.1 - Embedded NEC-E HW release 5.0
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05	7.05.2013	David	<ul style="list-style-type: none"> - ES10 appl. SW release 3.12 - ES10 HW release 6.0 - NEC-E appl. SW release 3.3.1 - NEC-E Bootloader SW release 2.1 - Embedded NEC-E HW release 5.0 - Exclusion of ES26 (product terminated)
06	19.08.2013	David	General Update
06	19.08.2013	David	New firmware version

SAFETY INSTRUCTIONS

NOTICE



Read this chapter containing safety instructions before operating the system for the first time or carrying out any modifications to the device.

It is also recommended to re-read the chapter at certain intervals in order to refresh your knowledge about safety.

The device may only be operated by **personnel who have received the necessary training in handling optical and electrical equipment and have been instructed in laser safety.**

- **General Safety Instructions**



Please read all instructions completely and carefully before putting into operation!

All operation steps should be carried out in the prescribed sequence!

Improper putting into operation can cause death or serious physical harm of persons or damage the devices.

NOTICE

Operational Personnel

The device may only be operated by personnel who have received the necessary training in handling optical and electrical equipment and have been instructed in laser safety.



Installation Locations

The device shall only be operated in locations with restricted or controlled access.

- **Laser Safety Classification**



Class 1M Product.

The device is classified according to the international standard IEC 60825-1:2007; European Version EN 60825-1:2007 and German Version DIN EN 60825:2008-05). It is assigned to

Class 1M

The laser radiation is emitted in the **invisible** infra-red spectrum range. It is potentially hazardous when viewed using an optical instrument.

Operation and maintenance of the device must only be carried out by persons who have received adequate training in laser safety. It must be installed according to BKtel instructions. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

NOTICE

Hazard Level 1M

The device may be integrated in an optical fiber communication system (OFCS) complying with IEC 60825-2. The standard requires the assessment of hazard levels at all accessible locations as a replacement for classifications according to IEC 60825-1. If installed in an OFCS the device optical output port(s) (fiber connector(s)) are assigned to the

Hazard Level 1M

This hazard level assignment is based on the laser radiation which is accessible when the optical fiber connector of the output port(s) is disconnected. The laser radiation is potentially hazardous when viewed using an optical instrument.

For subsequent accessible locations within the OFCS the manufacturer of the OFCS is obliged to assign appropriate hazard levels and to install applicable laser safety measures according to IEC 60825-2.

- **Location of Laser Apertures**

The location of the emitting fiber connector(s) at the front or rear side (optional) of the device can be seen in chapter 3.6 and 3.7 of this operating manual. Emission is indicated by an LED on the front panel as shown in chapter 3.6. In case of a not connected fiber connector laser radiation will be emitted as a divergent optical beam (divergence angle $\Phi = 0.23$ rad) which is 4° off the fiber axis to the right in direction of beam propagation. The laser radiation has a maximum optical power of 20.0 mW at a wavelength between 1530 nm and 1565 nm.

- **Laser Safety Instructions**

- The device should be shut down, put into a low power state or disconnected before any work is completed on exposed fiber, connectors, etc.
- Check optical power in a fiber using a calibrated optical power meter.
- Do not stare directly into the optical beam and do not use any unapproved collimating device to view the fiber ends or connector facets. This includes magnifying devices such as eye loupes, magnifiers and microscopes which are used in a distance of less than 100 mm from the connector facet.
- If it is necessary to look at fiber ends or connector facets with optical instruments: Ensure that the fibers do not transmit optical power. Therefore use a calibrated optical power meter
- If the laser safety or hazard level requires the use of eye protection, only use equipment which has been tested and approved for the wavelengths and optical power involved.
- Do not point fiber ends at other people.
- Any single or multiple fiber ends or ends found not to be terminated with power levels exceeding hazard level 1 (acc. IEC 60825-2) should be individually or collectively covered when not being worked on. Use only covers or covering material with sufficient attenuation of the optical power at the wavelength concerned. Sharp ends should not be exposed.
- When using optical test cords, the optical power source shall be the last to be connected and the first to be disconnected.
- Do not make any unauthorized modifications to any optical fiber system or associated equipment.
- Replace damaged optical safety labels or attach new labels if labels are missing.
- Use test equipment of the lowest class necessary and practical for the task. Do not use test equipment of a higher class than the location hazard level.

Parts List

This document contains the description for the following units:

Unit	Description
Transmitter unit	Modular external modulated 1550 nm optical transmitter basic unit for CATV ES10L ES10XL Fx-ES10XL
I/O ports	Not for ES10L-types
Power supply + fan module	Power supply + fan module 100 VAC ... 240 VAC
	Power supply + fan module ± 36 VDC ... ± 60 VDC
	Fan-only module
Optical interface	SC-APC optical connector, 8° angle
	SC-APC optical connector, with shutter
	FC/APC optical connector, JDS-standard (default)
	FC/APC optical connector, NTT-standard (option)
	E2000 – 0.1 dB optical connector

The ES10 is available as an OEM product with customized front panel printing.

1 TYPE INFORMATION

Transmitter characteristics

Type	Opt. output power	SBS Threshold	Freq. Plan	NMS Interface	I/O ports	Wave-length	Opt. connector	RF-input Opt. Output	OEM Version	Power supply
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Types

Property	Key	Meaning
Version	ES10 Fx-ES10	47...1006 MHz
Type	XL L	XL L
Opt. output power	70 85 100	+7.0 dBm (ES10L) +8.5 dBm (ES10XL, Fx-ES10XL) +10 dBm (ES10XL, Fx-ES10XL)
SBS threshold	165 190	+16.5 dBm (fix, only L-type) +13.0 ... +19.0 dBm (adjustable)
Frequency plan	PFQ344044 C42 N77 PAL84 xxx	PFQ344044 C42 N77 PAL84 Customer specifics
NMS interface	A B	HTTP / SNMP Ethernet RS485
I/O ports	I	
Wavelength	X 15xx.xx	1548....1560nm 15xx.xxxnm ITU Wavelength
Optical connector	1 2 3 4 5	E2000 SC/APC FC/APC-NTT FC/APC-JDS SC/APC with shutter
RF-input / opt. output	F R	On front side On rear side
OEM Version	0 OEM	BKtel OEM Version
Power supply	230/230 48/48 230 48 230/48	2 x (100 ... 240 VAC) 2 x (±36 ... ±72 VDC) 1x (100 ... 240 VAC) 1 x (±36 ... ±72 VDC) mixed 230 VAC/ 48 VDC

Example Transmitter characteristics: ES10XL-85-190-N77-A-I-1558.99-2-F-0-230/230:

Optical transmitter type ES10XL with (2x) 8.5 dBm output power, max. 19 dBm SBS threshold, calibrated for NTSC77 frequency plan, with HTTP/SNMP Ethernet NMS interface, with I/O ports, operating nominally on 1558.99 nm, with SC/APC connectors, RF input on the front and optical outputs at the rear side, BKtel version with dual 100 ... 240 VAC power supplies.

2 GENERAL DESCRIPTION

2.1 Introduction

The optical transmitter ES10 represents a family of externally modulated 1550 nm DFB laser transmitters. These products have been developed to fulfill the requirements of modern Hybrid Fiber Coax networks for the transmission of CATV, cable phone and cable data signals. There are currently 2 different base versions available:

- ES10L for applications with moderate fiber length of ≤ 65 km. This version features a SBS threshold of 16.5 dBm, a narrow linewidth laser (0.65 MHz), output power of 2×7 dBm (-70 version), an 10/100 Ethernet Webserver and SNMP interface for EMS/NMS (element/network management systems) or alternatively an RS485 interface for EMS only.
- ES10XL for applications with very long fiber length exceeding 65 km. This version is designed for highest requirements on transmission performance and features. It offers a SBS threshold which can be adjusted between 13 and 19 dBm, a very narrow linewidth laser (0.3 MHz), output powers of $> 2 \times 8.5$ (-85 version) and 2×10 dBm (-100 version), ITU-grid compatible wavelength which can be adjusted by ± 100 GHz, an 10/100 Ethernet Webserver and SNMP interface for EMS/NMS (element/network management systems) or alternatively an RS485 interface for EMS only.

Future proof operation is accomplished due to the possibility to download updates of network controller firmware and transmitter firmware.

The ES10 is offered for 4 different standard frequency plans. Specifications for other frequency plans are available on request.

The optical transmitter comes in a 1 unit high 19" housing. Fig. 2.1.1 shows the ES10 with RF_{IN} socket, $RF_{Monitor}$ socket and optical connectors on the front panel. Optionally these connectors can be located on the rear panel.



Fig. 2.1.1. ES10

A Liquid Crystal Display (LCD) provides information about actual settings and properties. 6 push buttons are used to enter data locally. The background light of the LCD is switched on automatically when a push button is pressed.

The ES10 provides plug in power supply modules. The power supply modules are offered in 2 different input voltage specifications: 100 ... 240 VAC and ± 36 ... ± 60 VDC. One feature of the ES10 is the possibility to use two different power supply + fan modules in one transmitter: e.g. power supply + fan module #1 could be a 100 ... 240 VAC unit, power supply + fan module no. 2 could be a ± 36 ... ± 60 VDC unit.

The optical interface can be ordered with optical connectors as specified in chapter 1. Without the need of using special tools it is possible to change the optical interface by replacing the optical connector interface plate by another one as specified.

For connecting the transmitter with an EMS (element management system) or a NMS (network management system) an Ethernet 10/100 Base-T Ethernet interface is available at the rear side of the ES10 (a-version). This Ethernet interface supports SNMP and HTTP protocols. The IP address for the integrated Webserver can be modified by using the push buttons at the front panel or the USB local interface at the rear side.

An additional RS485 (master) interface has been implemented at the ES10XL a to poll other equipment like EDFAs or optical switches.

Five general purpose input/output ports are available via a mini-DIN connector on the rear side of the transmitter. Port #0 and port #1 are I/O ports, port #1 to port #4 are input-only ports. The ports can be used for additional alarm or remote functions. They are accessible via the Webserver interface.

The ES10 b-version offers two RS485 (slave) interfaces for EMS or NMS. Furthermore, there is one alarm output, which can be used for simple alarm messaging functions.

2.2 Principle of Operation

The transmitter is based on five functional blocks: RF-path, cw-DFB-laserdiode, integrated optical modulator, control electronics and power supply. The functional diagram is shown in Fig. 2.2.1.

The RF input signal is fed into a preamplifier including an automatic gain control circuitry. The AGC stabilizes the output signal of the preamplifier to maintain a stable RMS- (root-mean-square) optical modulation index (OMI) of the optical modulator. Input level variations are compensated as long as the AGC circuit is working in its nominal gain range.

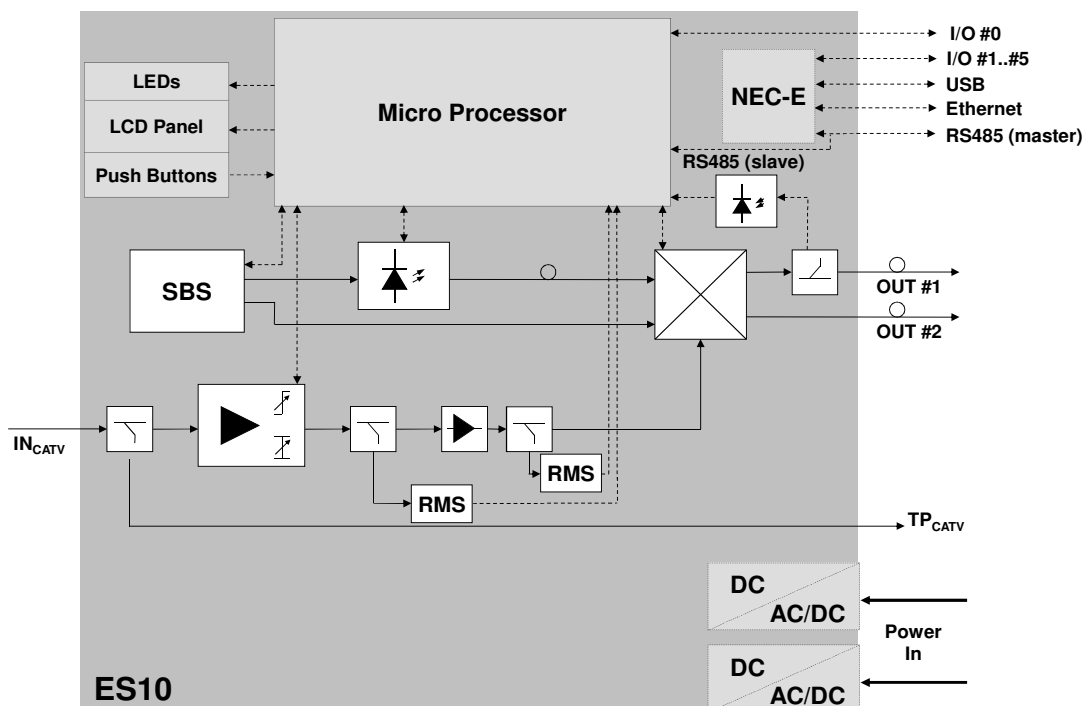


Fig. 2.2.1. ES10 Block Diagram

The AGC can be turned off for a constant gain operation in order to tailor the CNR/CSO/CTB performance to the used frequency plan and the requirements of the customer. The function is accessible via the push buttons or the Ethernet interface.

The central core of the transmitter is the electrooptical modulator working as a Mach-Zehnder-interferometer. The light from the laserdiode is coupled into an optical strip waveguide. An integrated optical splitter divides the light into two identical portions which are phase modulated by an RF signal applied to the electrodes of the modulator. The concept of the electrodes results in a push pull phase modulation of both branches. Following the modulating section the signals of both arms are combined and interfere. The interference of the phase modulated signals results in an amplitude modulation of the output light signal which is available on both outputs of the combiner.

The necessary cw input light for the modulator is produced by a DFB laserdiode working with 1550 nm wavelength. There are two control loops for operating the laserdiode at constant optical output power as well as at constant temperature by means of a thermoelectric cooler. The ES10XL has been designed for DWDM applications and allows tuning the operation frequency (wavelength) by ± 100 GHz in steps of 50 GHz. The laserdiode operating current is controlled in order to compensate for ageing effects. The temperature of the laserdiode is controlled by regulating the required drive current for the thermoelectric cooler. At 90% of the available cooler drive current and/or $>130\%$ of the initial laserdiode operating current a warning is generated which indicates ageing. At 100% cooler drive current the laserdiode operating current is switched off to protect the laserdiode against irregular temperature conditions and an alarm is generated indicating severe malfunction. Both types of indications are causing the corresponding LED on the front plate of the optical transmitter to emit. In case of a warning the LED lights yellow since the unit is still working properly, however close to its limits. In case of an alarm the LED is emitting red light. The messages to the network management system are of course more detailed. They include the actual values of the currents and temperature as well as alarm flags.

To suppress the Stimulated Brillouin Scattering (SBS) the wavelength spectrum of the optical signal is broadened. Two technologies are used:

- Broadening the optical spectrum by modulating the laserdiode operating current
- Broadening the optical spectrum by driving an optical phase modulator

These SBS circuits are mandatory to avoid stimulated Brillouin scattering in optical fibers and allow operation with optical amplifiers feeding at least +13 dBm of optical power into standard single mode fibers. For the XL-version of the transmitter all microwave signals can be adjusted in amplitude via the push-buttons on the front panel to optimize the SBS and SPM (self phase modulation) performance.

The coupling of light from the laserdiode into the modulator is performed by using polarization maintaining optical fiber. The optical modulator provides two optical outputs. The signal of one of these outputs is tapped to an InGaAs photodiode. The electrical signal of this photodiode is evaluated for two reasons to supervise a proper working of the cw laserdiode. In case of optical output power out of limit an alarm is generated.

When switching on the ES10, the transmitter starts up adjusting the bias point of the electrooptical modulator by output power regulation, it's called "Output power based". After warm up sequence the bias point of the electrooptical modulator is evaluated by one of two methods (the states are shown in the parameter menu):

1. Channel controlled:

A detector circuit measures CSO and (indirectly) CTB distortions to optimize the bias point of the electrooptical modulator. For a proper operation of the detection circuit at least two analog modulated TV carriers (no back off) with a frequency spacing of 24 MHz have to be present. Using this standard software setting of the detection scheme (Channel Distance -

> 8 MHz) all known European and Chinese frequency plans are supported: CENELEC frequency plan, all regular 6 and 8 MHz spacing frequency plans as well as the German 7/8 MHz frequency plan. Additionally it is possible to change the standard software setting of Channel Distance to 6 MHz (which will be the same as 8 MHz) and to 7 MHz, to work with regular 7 MHz frequency plans (at least two analog modulated TV carriers with a frequency spacing of 21 MHz) via push-buttons on the front panel or via the NMS interface.

The “channel controlled” mode will work also for QAM modulated carriers if one of the following configurations is given:

- a) One pair (=2) QAM carriers with carrier frequency spacing of 24 MHz and OMI $\geq 14\%$ per QAM carrier
 - b) Two pairs (=4) QAM carriers with each pair having a carrier frequency spacing of 24 MHz and OMI $\geq 10\%$ per QAM carrier
 - c) Four pairs (=8) QAM carriers with each pair having a carrier frequency spacing of 24 MHz and OMI $\geq 7\%$ per QAM carrier
 - d) and so on ...
2. Pilot controlled:
An internal pilot tone is used to check for distortion products out-of-band. Service signal frequency range 47 to 1006 MHz is not targeted by pilot tone control.

The method used for CSO regulation is shown in the parameter page of the webserver (see ‘Regulation state’ in Fig. 6.5.10). It is recommended to set the regulation mode to “Pilot controlled”. However when the RF input signals contains at least two analog modulated TV carriers with 24 MHz (or 21 MHz) spacing the CSO regulation mode can be used instead.

The ES10La/ES10XLa is equipped with 4 data interfaces at the rear side:

- USB interface for local management terminal (LMT),
- RS485 (master) for polling other BKtel equipment such as EDFAs or optical switches and translating this information to the Ethernet interface (HTTP and SNMP),
- Ethernet 10/100 Base-T supporting SNMP and Webserver (HTTP) protocols for interfacing to an EMS or NMS
- General purpose I/O interface

The ES10Lb/XLb is equipped with two RS485 (slave) interfaces for interfacing to an EMS or NMS. Additionally, there are two output ports available for simple alarm or warning messaging.

Plug in power supply/fan modules for different input voltages are available for 100 ... 240 VAC, 36 ... 60 VDC. Each module can be simply removed during operation without disturbing the operation of the transmitter.

2.3 Principle of Element Management

The interface configuration for Element Management or Network Management systems is shown in the next two figures for the ES10La/ES10XLa with embedded NEC (network element controller = SNMP Proxy Agent) and the ES10L/ES10XLb.

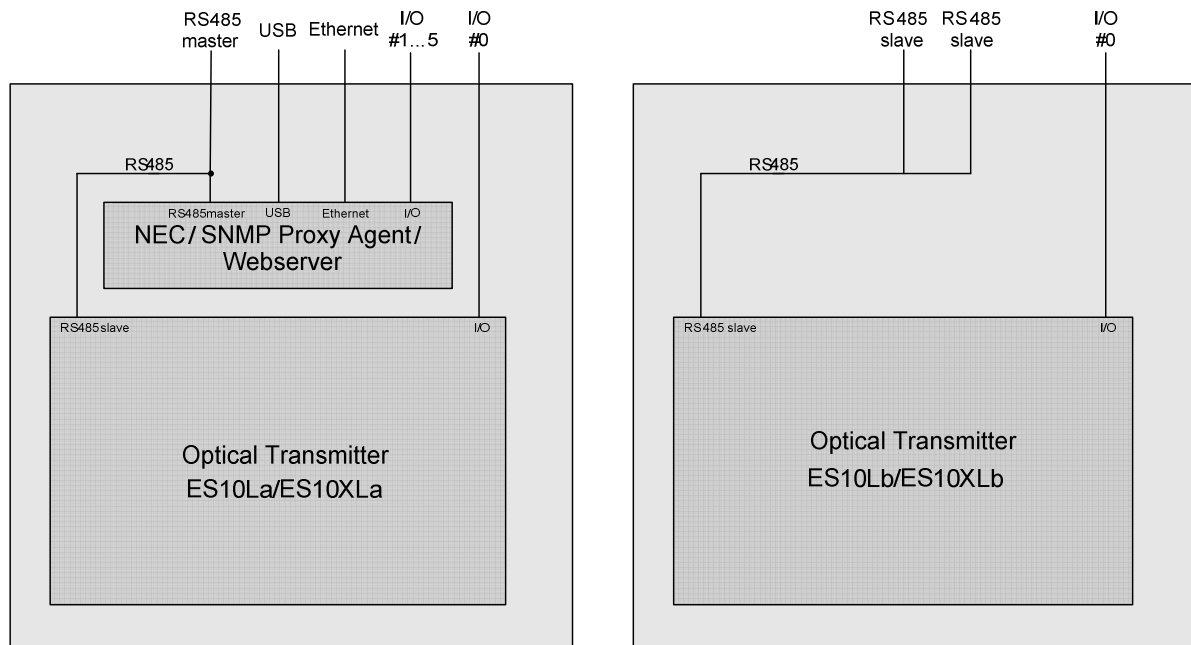


Fig. 2.3.1: EMS/NMS Interface (a) ES10La/ES10XLa (b) ES10Lb/ES10XLb

The ES10La/ES10XLa versions (ref. to Fig. 2.3.1 a) contain an embedded network element controller (NEC) which works as a SNMP Proxy Agent. All equipment (EDFAs, optical switches, receivers and power supplies) which is connected to the RS485 master interface and which support the BKtel RS485 protocol are polled. The received data is then translated into SNMP and HTTP and can be accessed via the Ethernet interface or locally via the USB interface. The NEC is able to poll up to 48 devices on the RS485 bus. On the I/O ports #1 ... 5 warnings/alarms collected from all polled devices can be accessed. The application software of the NEC can be updated easily in order to support new devices. An overview of software releases is given in chapter 10. BKtel offers the MIB-files for easy implementation of the SNMP interface into element/network management systems (EMS/NMS) such as Cablewatch (BKtel), HP Open View or Rosa (SA former Barco Networks).

The ES10Lb/XLb-versions (ref. to Fig. 2.3.1 b) does not contain an embedded NEC. The RS485 slave interface of the transmitter can be accessed directly, but should be connected to an external NEC-E (e.g. BKtel's Ethernet controller NEC-E in BK mechanics).

Fig. 2.3.2 shows how the ES10 interface to other devices and a SNMP EMS. The ES10 with embedded NEC (upper right corner) is connected to other (BKtel) devices via the RS485 interface. In the example there is an optical amplifier OVxxxxb (without embedded NEC) in 19"-1RU housing (similar to the ES10) and in total 4 subracks interfacing to the RS485 bus. A variety of BKtel devices which can be mounted on these subracks like EDFAs, optical switches, optical transmitters and receivers. For an actual overview please refer to www.bktel.com or contact BKtel directly. All of these connected devices only provide RS485 slave interfaces, since the NEC of the ES10 is the dedicated RS485 bus master, polling all other devices. The NEC (SNMP Proxy Agent) within the ES10 polls all devices and translates this information to Ethernet-HTTP and Ethernet-SNMP.

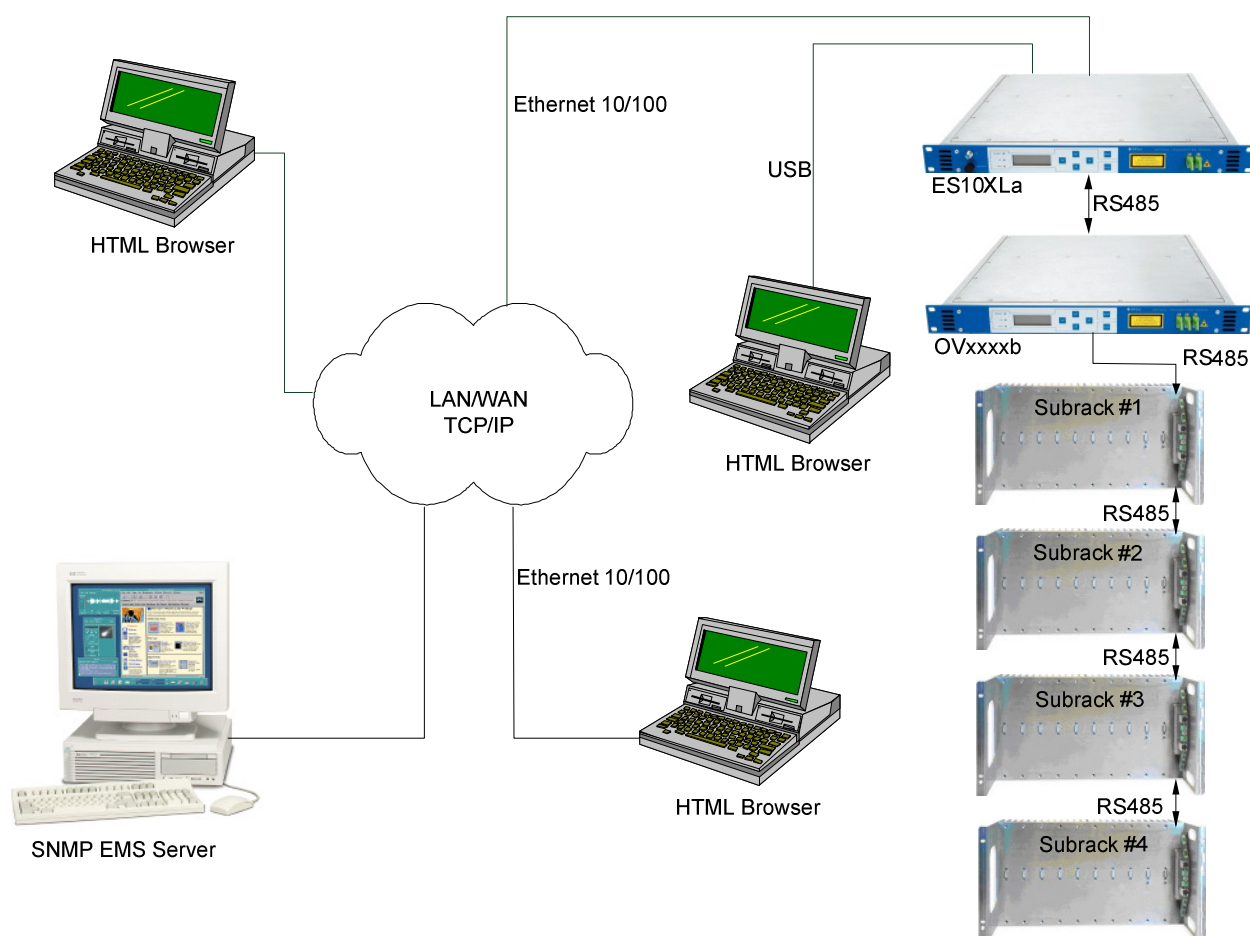


Fig. 2.3.2: The ES10XLa interfacing with other equipment and a SNMP EMS.

2.3.1 Webbrowser Communication

Management access on the embedded network element controller NEC-E is established with a webbrowser using the NEC-E IP address. Besides the webbrowser no other software is necessary. The access computer is only in need of an Ethernet interface; no dongles are required.

If the NEC-E is not connected to a LAN/WAN one can directly link the computer with the embedded NEC-E:

- 1) by crossed RJ45 cable to the Ethernet 10/100 Base-T interface

2) by the USB interface as local management terminal (LMT)

Also USB local interface and Ethernet interface can be used simultaneously.

As soon as the webbrowser establishes the link to the NEC-E, all chassis devices connected to the RS485 bus are listed on the start page. Clicking on a device listed in the menu "Devices" leads to further webpages, which allow supervision and adjustment of the selected device.

2.3.2 NMS Communication

The embedded network element controller NEC-E provides an HMS compliant SNMP protocol for communication with the server of a central (umbrella) network management system (NMS). SNMP MIBs are available on request.

The NMS can deal with the complete set of device management features by SNMP MIB, because all management functions are implemented in SNMP. Alarms are indicated by traps. Of course, decentralized network element controller access by webbrowser is simultaneously available.

3 TECHNICAL SPECIFICATIONS

3.1 ES10XL



Application

- ▶ External modulated 1550 nm DFB laser transmitter
- ▶ Electrical to optical conversion of multi-channel CATV video signals (AM-VSB, FM and QAM signals)
- ▶ Optical downstream transmission in HFC and RF Overlay networks with excellent performance
- ▶ Enables the usage of optical amplifiers (EDFAs) as boosters or repeaters in order to realize large scale HFC or FTTH networks

Features

- ▶ Two optical outputs with 8.5 or 10.0 dBm optical output power each
- ▶ Low noise, narrow linewidth CW DFB laser with DWDM wavelength according to ITU grid
- ▶ Adjustable wavelength +/- 100 GHz
- ▶ Bandwidth of 47...1006 MHz
- ▶ Improved RF signal performance up to 1006 MHz
- ▶ Enhanced SBS suppression
- ▶ Sophisticated SBS supervision functionality
- ▶ Automatic load control (ALC) for CATV signal input, ready for pure digital RF load
- ▶ Adjustable RF slope
- ▶ Front panel RF test point for CATV input signal
- ▶ High reliability dual, hot-plug-in power supply modules for 100...240 VAC or $\pm 36... \pm 60$ VDC
- ▶ HTTP (Webbrowser) and SNMP (a-version)
- ▶ LC display and LED status indication
- ▶ Ethernet, USB and general purpose I/O interface for remote control
- ▶ Very low power consumption
- ▶ Very thin, only 1 U design for mounting into 19", ETSI or JIS racks

General Technical Data

Optical connector		SC/APC, E2000
Optical fiber		Standard single mode 9/125 μ m
RF connector		F female, front or rear side mounted
Control interface		a-version: Ethernet 10/100 and USB interface b-version: RS485 interface
Power supply types (Dual redundant, hot pluggable)		100 ... 240 VAC, 50/60 Hz or ± 36 ... ± 60 VDC
(Real) Power consumption	[W]	< 50 / 56 (1 / 2 power supply unit(s) equipped)
	[VA]	< 51 / 57 @ 100V AC (1 / 2 power supply unit(s) equipped)
Enclosure		19" / 1 rack unit [U] (optionally compatible to ETSI or JIS standards)
Weight	[kg]	≈ 9.0 (depend on power supply)
Safety		EN 60950, Laser class 1M according IEC 60 825-1 (eyesafe for normal viewing)
EMC		EN50083-2
Climatic specification (operation)		ETS 300 019, class 3.1
Climatic specification (storage)		ETS 300 019, class 1.2

Optical Properties

		ES10XL-85	ES10XL-100
Wavelength	[nm]	1548...1560 or ITU grid ch 23...37	
Side mode suppression	[dB]	> 30	
Wavelength adjustment range	[GHz]	-100, -50, 0, 50, 100	
Optical power	[dBm]	2x 8.5 min.	2x 10.0 min.
Relative intensity noise for CATV (for optical fiber return loss > 40 dB)	[dBc/Hz]	< -158 (typ. < -160)	
SBS suppression	[dBm]	Threshold adjustable from 13 up to + 19 dBm (65 km standard fiber), +21.5 dBm (65 km SBS enhanced fiber) ¹⁾	
Maximum SBS suppression threshold ²⁾	[dBm]		
10 km		+25.5	
25 km		+23.5	
65 km		+21.5	
Laser linewidth (typical)	[MHz]	0.3	

¹⁾ SBS suppression threshold should be adjusted application individually as low as possible. Please see user manual for details.

²⁾ SBS enhanced fiber, for standard fiber -2.5 dB

Japanese channel allocation with 11 AM video carriers below 230 MHz with $OMI_{Peak} = 7.0\%$ measured with noise bandwidth of 4 MHz and 80 256QAM carriers with $OMI_{QAM} = 2.2\%$ measured with noise bandwidth of 5.274 MHz

Electrical Properties CATV

RF frequency range	[MHz]	47 ... 1006
Frequency response flatness		
47 ... 862 MHz	[dB]	± 0.75
47 ... 1006 MHz	[dB]	± 1.2 ¹⁾
Nom. Input level per TV channel	[dB μ V]	80
Input level range (per carrier)	[dB μ V]	78 ... 96 (for OMI = 5% per CATV carrier)
True RMS input level range	[dBm]	-16 ... +2 (for ALC correctly working with $OMI_{tot,rms} = 18.6\%$)
Slope range	[dB]	-2 (cable equivalent) ... +8 (cable equalization)
RF impedance	[Ω]	75
Return loss	[dB]	> 20 (@ 47 MHz) – 1.5 dB/octave, minimum 15
Test point attenuation	[dB]	-20 (-1.0 ... +1.0)

¹⁾ PFQ344044 transmitter version: ± 1.0

Performance Characteristics

Transmitter version		C42	PFQ344044	D84	N77
Channel allocation plan for test		CENELEC 42	European Load	PAL-D 84	NTSC 77 / Jap ¹⁾
Number of TV, FM, QAM carriers		42, 0,0	34, 40, 44	84, 0,0	77,0,0 / 11,0,80
Noise bandwidth	[MHz]	5	5	5	4 / 4
CNR Tx/Rx	[dB]	55.5	52.5	52.5	53.5 / 55
CNR Link 1	[dB]	55	52	52	53 / 54.5
CNR Link 2	[dB]	53	51	50.5	52 / 53.5
CNR Link 3	[dB]	50.5	49	49	50 / 51.5
CSO Tx/Rx and Link 1	[dBc]	65	73	65	65 / 70
CSO Link 2	[dBc]	63	72	65	65 / 70
CSO Link 3 @ output 1	[dBc]	62	67	63	65 / 70
CTB	[dBc]	65	72	65	65 / 66
CNR of QAM carriers Link 1	[dBc]	-	-	-	- / 43

Test Conditions

	Booster EDFA	1 st Fibre Length	In-Line EDFA	2 nd Fibre Length	RX
Tx/Rx	no	no	No	no	0 dBm
Link 1	no	35 km	No	no	0 dBm
Link 2	16 dBm	65 km	No	no	0 dBm
Link 3	13 dBm	52 km	13 dBm	52 km	0 dBm

¹⁾ RF input level at 80 dB μ V per TV carrier

²⁾ EDFA with noise figure N = 5 dB

³⁾ Non-dispersion shifted fiber

⁴⁾ Receiver Rx with equivalent input noise current density of $I_{EQ} = 7$ pA/ $\sqrt{\text{Hz}}$ and efficiency $\eta = 0.95$ A/W

3.2 ES10L



Application

- ▶ External modulated 1550 nm DFB laser transmitter
- ▶ Electrical to optical conversion of multi-channel CATV video signals (AM-VSB, FM and QAM signals)
- ▶ Optical downstream transmission in HFC and RF Overlay networks
- ▶ Enables the usage of optical amplifiers (EDFAs) as boosters or repeaters in order to realize HFC or FTTH networks

Features

- ▶ Two optical outputs with 7.0 dBm optical output power each
- ▶ CW DFB laser
- ▶ Bandwidth of 47...862 MHz
- ▶ Automatic load control (ALC) for CATV signal input, ready for pure digital RF load
- ▶ Adjustable RF slope
- ▶ Front panel RF test point for CATV input signal
- ▶ High reliability dual, hot-plug-in power supply modules for 100...240 VAC or $\pm 36... \pm 60$ VDC
- ▶ HTTP (Webbrowser) and SNMP (a-version)
- ▶ LC display and LED status indication
- ▶ Ethernet, USB and general purpose I/O interface for remote control
- ▶ Very low power consumption
- ▶ Very thin, only 1 U design for mounting into 19", ETSI or JIS racks

General Technical Data

Optical connector	SC/APC, E2000	
Optical fiber	Standard single mode 9/125 μ m	
RF connector	F female, front or rear side mounted	
Control interface	a-version: Ethernet 10/100 and USB interface b-version: RS485 interface	
Power supply types (Dual redundant, hot pluggable)	100 ... 240 VAC, 50/60 Hz or ± 36 ... ± 60 VDC	
(Real) Power consumption	[W]	< 50 / 56 (1 / 2 power supply unit(s) equipped)
	[VA]	< 51 / 57 @ 100V AC (1 / 2 power supply unit(s) equipped)
Enclosure	19" / 1 rack unit [U] (optionally compatible to ETSI or JIS standards)	
Weight	[kg]	\approx 9.0 (depend on power supply)
Safety	EN 60950, Laser class 1M according IEC 60 825-1 (eyesafe for normal viewing)	
EMC	EN50083-2	
Climatic specification (operation)	ETS 300 019, class 3.1	
Climatic specification (storage)	ETS 300 019, class 1.2	

Optical Properties

Wavelength	[nm]	1548...1560
Side mode suppression	[dB]	> 30
Optical power	[dBm]	2x 7.0 min..
Relative intensity noise for CATV (for optical fiber return loss > 40 dB)	[dBc/Hz]	< -158 (typ. < -160)
SBS suppression	[dBm]	Fixed threshold +16.5 dBm (65 km standard fiber), +19.0 dBm (65 km SBS enhanced fiber) ¹⁾
Maximum SBS suppression threshold ²⁾	[dBm]	
10 km		+23.0
25 km		+21.0
65km		+19.0
Laser linewidth (typical)	[MHz]	0.65

¹⁾ SBS suppression threshold should be adjusted application individually as low as possible. Please see user manual for details.

²⁾ SBS enhanced fiber, for standard fiber -2.5 dB

Electrical Properties CATV

RF frequency range	[MHz]	47 ... 862
Frequency response flatness 47 ... 862 MHz	[dB]	± 0.75
Nom. Input level per TV channel	[dB μ V]	80
Input level range (per carrier)	[dB μ V]	78 ... 96 (for OMI = 5% per CATV carrier)
True RMS input level range	[dBm]	-16 ... +2 (for ALC correctly working with $OMI_{tot,rms} = 18.6\%$)
Slope range	[dB]	-2 (cable equivalent) ... +8 (cable equalization)
RF impedance	[Ω]	75
Return loss	[dB]	> 20 (@ 47 MHz) – 1.5 dB/octave, minimum 15
Test point attenuation	[dB]	-20 (-1.0 ... +1.0)

Performance Characteristics

Transmitter version		D84
Channel allocation plan for test		PAL-D 84
Number of TV, FM, QAM carriers		84, 0, 0
Noise bandwidth	[MHz]	5
CNR Tx/Rx	[dB]	52.5
CNR Link 1	[dB]	51.5
CNR Link 2	[dB]	49.0
CNR Link 3	[dB]	46.5
CSO Tx/Rx and Link 1	[dBc]	65
CSO Link 2	[dBc]	65
CSO Link 3 @ output 1	[dBc]	63
CTB	[dBc]	65

Test Conditions

	Booster EDFA	1 st Fibre Length	In-Line EDFA	2 nd Fibre Length	RX
Tx/Rx	no	no	No	no	0 dBm
Link 1	no	35 km	No	no	0 dBm
Link 2	16 dBm	65 km	No	no	0 dBm
Link 3	13 dBm	52 km	13 dBm	52 km	0 dBm

¹⁾ RF input level at 80 dB μ V per TV carrier

²⁾ EDFA with noise figure N = 5 dB

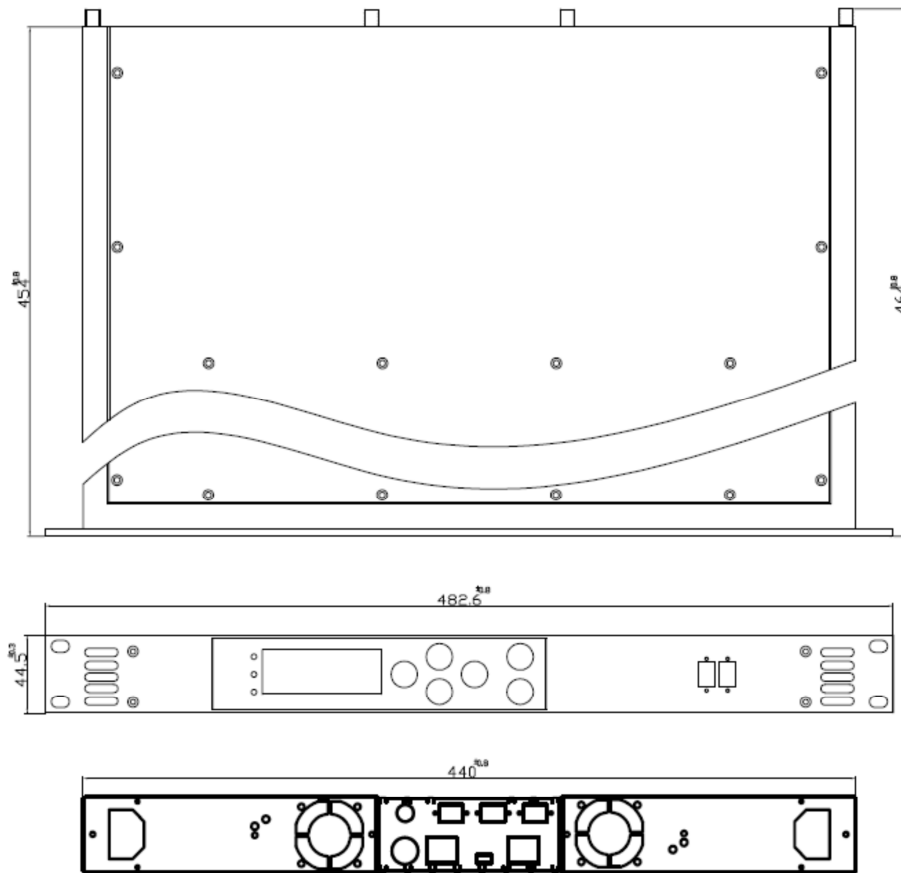
³⁾ Non-dispersion shifted fiber

⁴⁾ Receiver Rx with equivalent input noise current density of $I_{eq} = 7 \text{ pA}/\sqrt{\text{Hz}}$ and efficiency $\eta = 0.95 \text{ A/W}$

3.3 Fx-ES10XL

For technical specifications please contact BKtel.

Dimensions



3.4 I/O Ports

3.4.1 ES10La/ES10XLa ((a-versions)

The ES10La/ES10XLa is equipped with 2 general purpose I/O and 4 input-only binary mode ports. The ports can be configured via the Webserver (HTTP) interface. The schematics of these ports are given below.

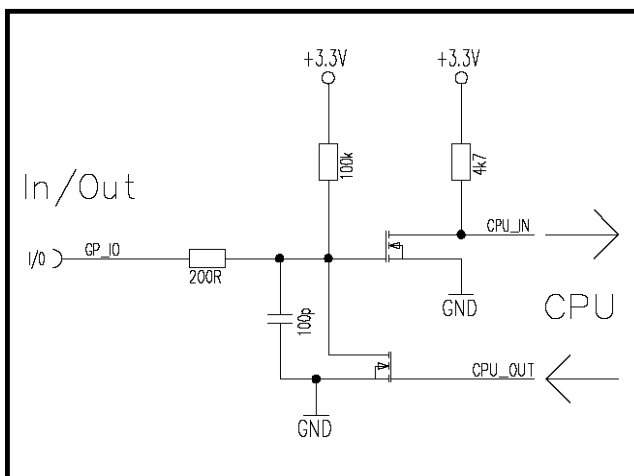


Fig. 3.4.1: Schematics of I/O port

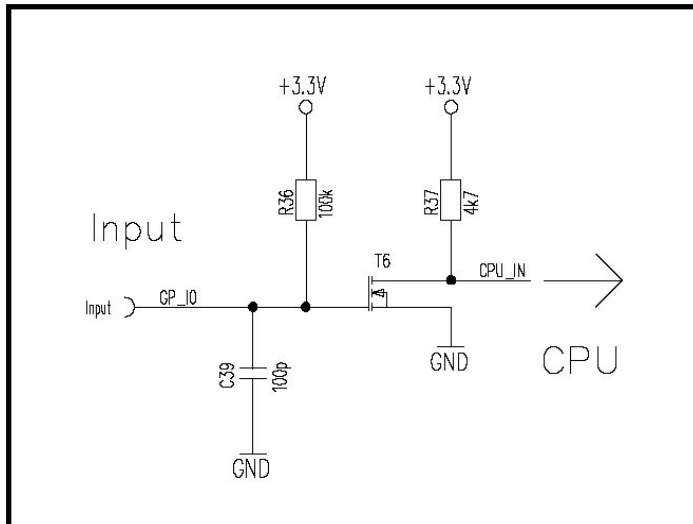


Fig. 3.4.2: Schematics of input-only port

Notes:

- The maximum voltage applied to all ports should be not below GND level and should not exceed +5 VDC.
- The input level for input high should be >1.6 V; the input level for input low has to be < 0.8 V.
- The input-only port and the open drain output port have a pull-up resistor of about 100 kΩ towards 3.3 V.
- The active low output resistance to GND of the output port is < 210 Ω.

The ES10 uses an 8 pin Mini-DIN connector for external Input/Output handling. The connector is located on the backside of the device near to the NMS RS485 Master connector.

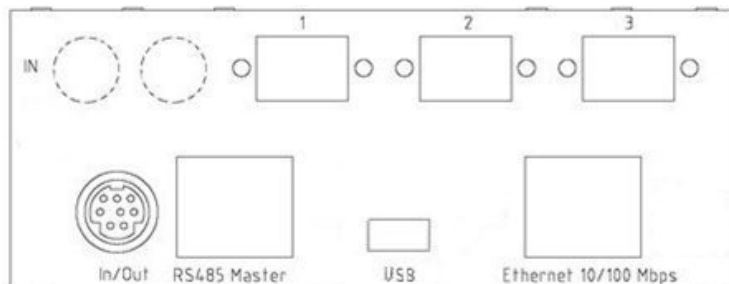


Fig. 3.4.3: ES10 rear side connectors

Fig. 3.4.4 shows the view on the 8 port mini-DIN connector

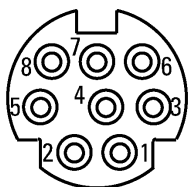


Fig. 3.4.4: 8 pin mini-DIN connector pinout

The mini-DIN connector pins are used as described in the following table.

Function in ES10	Pin Number of mini-DIN connector	Comments
GND	2	Ground
+5.1 VDC (+/- 5%) (voltage under no-load condition)	1	Max. 80 mA, protected by a serial Fuse (< 6 Ohms)
Input / Output #0	5	Used for redundancy switching feature (input port) or as alarm output port.
Input / Output #1	7	Either Input or Output, configurable by Software;
Input only No.2	3	Input mode configurable by Software
Input only No.3	8	Input mode configurable by Software
Input only No.4	4	Input mode configurable by Software
Input only No.5	6	Input mode configurable by Software

Table 1. Mini-DIN-connector pin assignment of I/O ports

Notes:

- On pin 1, there is a 5.1 VDC (+/- 5 %) supply voltage available for feeding an external interface box, which e.g. could contain optocouplers or relays, external sensors etc.; the current drawn from this port should not exceed 80 mA.
- I/O #0 is directly related to the transmitter. If the port is used as an output, alarms related to the transmitter can be accessed on this output. If the port is used as an input it enables easy redundancy switching between two redundant ES10. For details please refer to 5.7 and 6.5.10.
- I/O #1 to #5 are directly related to the NEC. The output port I/O # 1, can therefore be used to display a warning or an alarm, if
 - one of the (up to 48) RS485-pollled devices or
 - the ES10 or
 - at least one of the input ports (I/O #2..5), which has been set to indicate a warning or an alarm,
 exhibits a warning or an alarm. For details please refer to 5.7.
- All I/O ports can be addressed and configured via the Ethernet Webserver (HTML) interface or via SNMP.
- In order to not degrade the EMI performance of the ES10, a shielded cable with the shield connected to pin 2 (GND) of the mini-DIN-connector has to be used.

3.4.2 ES10Lb/ES10XLb (b-versions)

The ES10Lb/XLb is equipped with one I/O port. The schematic is given in Fig. 3.4.5. It uses an 8 pin Mini-DIN connector for external input/output handling. The connector is located on the backside of the device near to the NMS RS485 Slave connector.

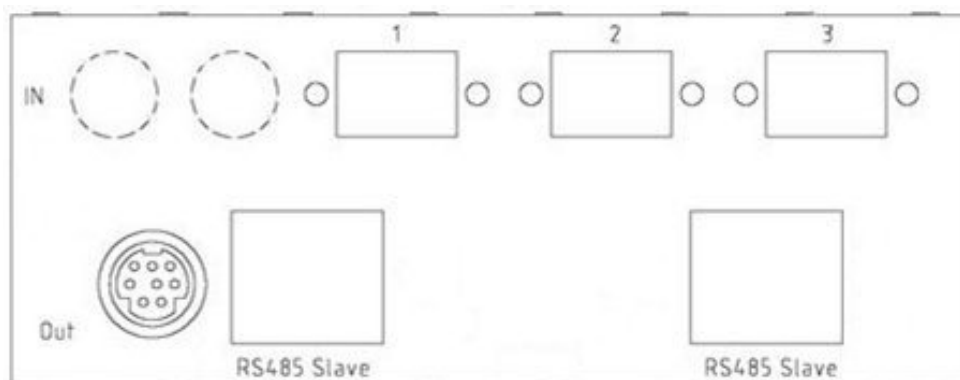


Fig. 3.4.5: ES10Lb/XLb rear side connectors

Fig. 3.4.6 shows the view on the 8 port mini-DIN connector

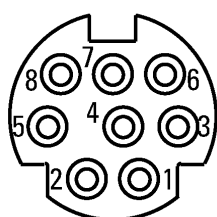


Fig. 3.4.6: 8 pin mini-DIN connector pinout:

The mini-DIN connector pins are used as described in the following table.

Function in ES10L/ES10XL (b-versions only)	Pin Number of mini-DIN connector	Comments
GND	2	Ground
+5.1 VDC (+/- 5%) (voltage under no-load condition)	1	Max. 80 mA, protected by a serial Fuse (< 6 Ohms)
Input / Output No.0	5	Used for redundancy switching feature (input port) or as alarm output port.
Input / Output No.1	7	N/A
Input only No.2	3	N/A
Input only No.3	8	N/A
Input only No.4	4	N/A
Input only No.5	6	N/A

Table 3.4.2.1: Mini-DIN-connector pin assignment of I/O ports

Notes:

- On pin 1, there is a 5.1 VDC supply voltage available for feeding an external interface box, which e.g. could contain optocouplers or relays etc.; the current sink from this port should not exceed 80 mA.

- In order to not degrade the EMI performance of the ES10, a shielded cable with the shield connected to pin 2, (GND) of the mini-DIN–connector has to be used.
- I/O #0 is directly related to the transmitter. If the port is used as an output, alarms related to the transmitter can be accessed on this output. If the port is used as an input it enables easy redundancy switching between two redundant ES10. For details please refer to 6.5.8.

3.5 EMS / Service Interfaces

3.5.1 NMS server interface: Ethernet 10/100Mbps (a-versions only)

The NMS server interface is the main NMS interface of the optical transmitter. It supports HTTP and SNMP protocols. The NMS server firmware can be downloaded for future software upgrades.

3.5.2 Local Management Terminal: USB interface (a-versions only)

The USB interface can be used as a user interface for local management of BKtel devices. When the USB interface of the embedded NEC-E is connected to a PC an additional virtual LAN interface becomes available. This new PC LAN interface gets automatically configured by the NEC-E using DHCP. This USB LAN interface is based on the Remote NDIS (RNDIS) specification from Microsoft. The NEC-E local management is done by using a web browser in the same way as when communicating over the NEC-E Ethernet interface.

3.5.3 BK device bus interface: RS485-master (a-versions only)

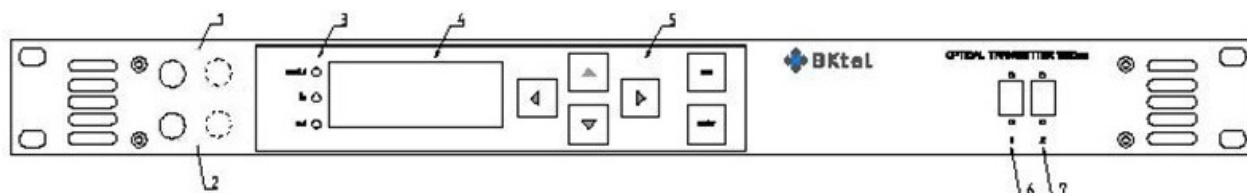
The RS485 bus interface can be used to connect more devices to be managed by the Ethernet NMS server interface installed in the optical transmitter. The ES10 in this case works as a network element controller (RS485-master), which polls all equipment that is connected to the RS485 port.

3.5.4 BK device bus interface: RS485-slave (b-versions only)

The RS485-slave interfaces can be used to manage the ES10L/ES10XLb, which means to read data and to change settings.

3.6 Front Panel

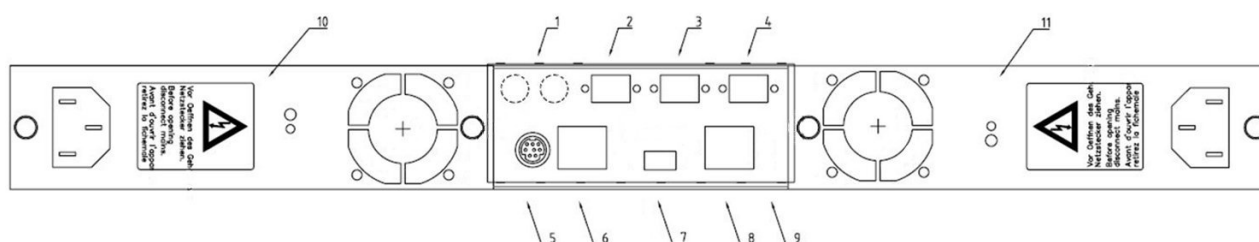
The following figure shows an example of the front panel view of the ES10. The RF-input and the optical connectors are optionally available on the rear panel.



Item #	Function
1	RF-input (optionally available on rear side)
2	RF-monitor output
3	Status LED's
4	Liquid Crystal Display
5	Push button field for local set-up of transmitter
6, 7	Optical connectors (optionally available on rear side)

3.7 Rear Panel

The rear panel is described in the following list:



Item #	Function
1	RF-input (optional located on front panel)
2, 3	Optical fiber outputs (optional located on front panel)
4	Not used in ES10, cover
5	I/O ports
6	RS485 interface (RJ-45 female): a-versions: master; b-versions: slave
7	USB interface (a-version only)
8	a-versions: Ethernet interface; b-versions: RS485 slave interface (RJ-45 female)
9	2 green LEDs Ethernet link & data (a-versions only)
10, 11	power supply + fan modules (field replaceable)

3.8 Power Supply and Fan Modules

There are 3 different types of power supply and fan modules available for the ES10. All of them can be either mounted on the left hand or right hand side.

It is possible to replace or exchange all of the modules during operation. This offers a big flexibility to the end user in order to customize the ES10 exactly to the actual needs.

The necessary outlets for the power supply modules have to be located in the proximity of the device and have to be easily accessible.

3.8.1 100 – 240 VAC module

Fig. 3.8.1 provides a view on the 100 – 240 VAC power supply and fan module. There is a AC mains input. There is one LED indicating the status of the power supply module. The power unit O.K. LED is lightening green when the power supply module is working properly.

The power supply and fan modules might be exchanged during operation (hot plug-in technology) with neither harm the equipment nor having any impact on the operation of the transmitter in case of a properly working backup power supply.

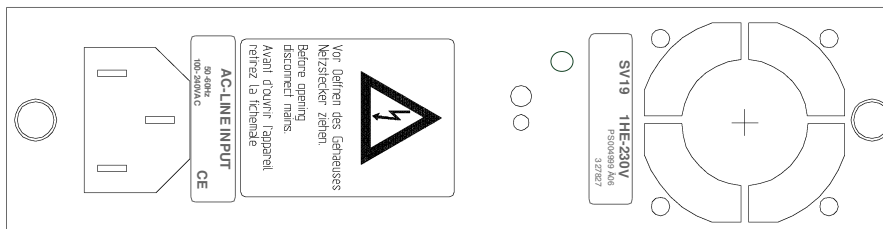


Fig. 3.8.1: 100 ... 240 VAC power supply and fan modules

3.8.2 ± 48 VDC module

Fig. 3.8.2 shows the ± 48 VDC power supply and fan module. There is a ± 48 VDC cable terminal in order to connect the supply voltage. It is important to take care of the correct polarity of the DC supply voltage, either 0 or +48 VDC connected to the – and + terminals, respectively or 0 and –48 VDC connected to the + and – terminals, respectively.

A fuse and a spare fuse are implemented inside the power supply and fan module and can be replaced if required. There is one LED informing about the status of the power supply module. The power unit O.K. LED is lightening green indicating that the power supply module is working properly.

The power supply and fan modules can be exchanged during operation (hot plug-in technology) with neither harming the equipment nor having any impact on the operation of the transmitter in case of a properly working backup power supply.

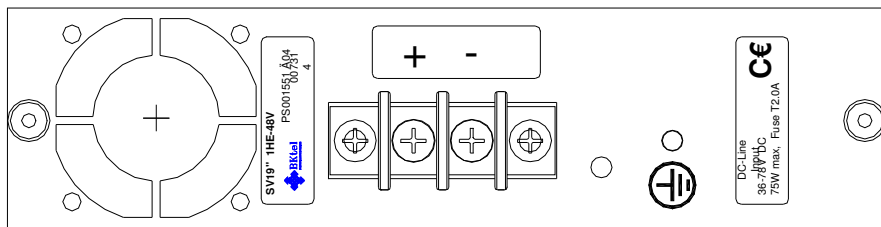


Fig. 3.8.2: ± 48 VDC power supply and fan modules

3.8.3 Fan-only module

For applications, where only one power supply is required, BKtel offers a fan-only module. Fig. 3.8.3 provides the view on the fan-only module.

The fan-only module can be exchanged during operation (hot plug-in technology) with having neither harming to the equipment nor having any impact on the operation of the transmitter in case of a properly working power supply.



Fig. 3.8.3: Fan-only module

3.9 Labeling

The optical transmitter carries a label specifying hardware model, product number, hardware release and the ordering number (Fig. 3.9.1). Fig. 4.8.2 reveals the characteristics of the device with all options (ref. to chapter 1). Fig. 3.9.3 specifies the MAC address if applicable. In case of questions please specify all these information when communicating with BKtel or sales representatives.



Fig. 3.9.1. Device label with product number and serial number

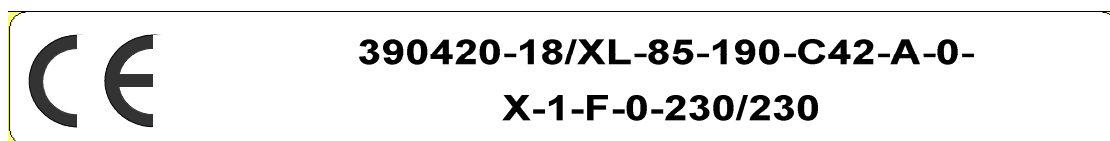


Fig. 3.9.2. Label with product number and all characteristics (ref. to chapter 1)



Fig. 3.9.3. MAC Address

4 OPERATING THE ES10

4.1 Handling Optical Components

4.1.1 Handling Optical Fibers

The smallest permissible bending radius for fibers used to connect HFC equipment is currently 30 mm (diameter of 60 mm, G652.D) or 15 mm (diameter of 30 mm, G.657.A). A smaller radius significantly increases attenuation of the fiber optic cables and even damages the fibers. Therefore, handle the fibers carefully, especially during installation.

4.1.2 Connecting and Disconnecting Optical Connectors



Please proceed in 1 the reverse order for disconnecting optical links.

For connecting optical links:

1. Loosen the dust caps from the transmitter's optical port (1) and fiber patch cord.
2. Note the orientation of the device's optical connector (2)! Plug the optical male connector of the patch cord in a sliding matter into the female connector of the device.
3. Save the dust caps.



Do not stare into the laser beam or view directly with optical instruments!

In order to prevent uncontrolled emission of laser beams, close the optical line connector immediately after opening the connection, using the dust caps designed for this purpose.

4.1.3 Cleaning Optical Connectors

When a connector has been connected and disconnected several times, it may be necessary to clean the plug pins or adaptor casing.

Only those cleaning agents and materials which have been authorized by the manufacturer may be used:

- Cleaning cloths made of fluff-free, disposable paper (Kimwipes from Kimberly-Clark)
- Cleaning fluid: Isopropanol min. 99 %
- Nylon brush (Curadent Co. Diamond)
- Brush (Co. Diamond Z-216/32)
- Rubber bellows (Co. Diamond Z-216/19)
- Compressed air



Laser Radiation

If you inspect the front of the plug when the equipment is switched on, there is a danger of damage to your eyes.

Therefore, always switch the equipment off for this kind of work. Use a measuring device to ensure that there is no laser beam emission from the fiber.

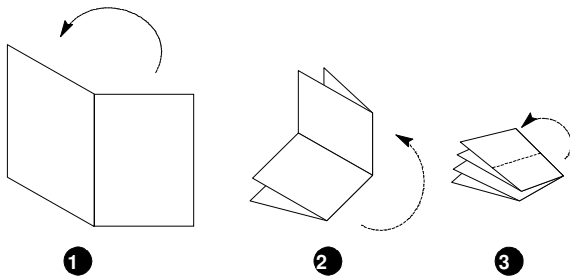


Do not touch the surface with your fingers when cleaning.

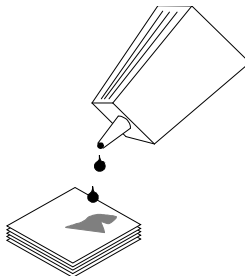
Plug pins with imprinted grooves on the front must only be daubed clean using a brush.

Dust or fluff can be blown away using the rubber bellows or dust-free compressed air.

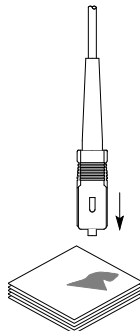
4.1.3.1 Cleaning the Plug Pins



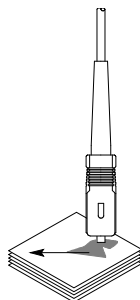
1. Fold the cleaning cloth three times. The cloth pad now constitutes an eight-layered cloth.



2. Moisten the folded cloth a little using the cleaning fluid, ensuring that a dry area remains.



3. Place the front surface of the connector, or the connector shaft on the moistened part of the cloth, pressing lightly. Let the cleaning fluid work into the dirt for a short time.



4. Move the connector to and from on the moistened part of the cloth, turning slightly and pressing lightly. Slide the front surface of the connector, or connector shaft, from the moist to the dry area, without breaking the surface contact with the cloth, so that no cleaning agent residue is left.

NOTICE

If the result of cleaning is not good, repeat the procedure.

5. Reconnect the connector or close it immediately with a dust cap.

4.1.3.2 Cleaning the Connector

NOTICE

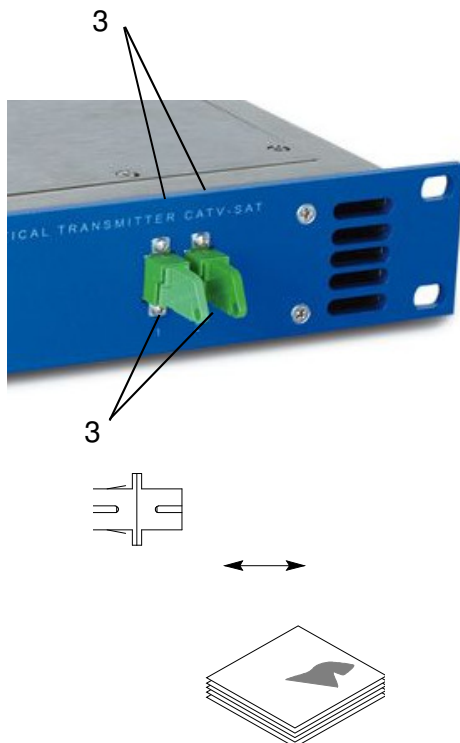
Cleaning the device connector(s) requires device opening.

Since device opening may damage its function, warranty extinguishes when doing so!

Therefore, cleaning the connector may be only performed by BKtel manufacturing engineers or BKtel repair engineers. Please send device to BKtel in case you assume dirty device's adaptors and/or connectors.

NOTICE

Only clean device's adaptor and adaptor case when no connector is connected. Extremely dirty adaptors must be replaced.



1. Disconnect the optical connector or remove the dust cap from the adaptor.
2. Dissolve both screws of each optical connector. Caution: Extract the connector very carefully!
3. Disconnect the internal optical connector (inside the device) and clean it as described in the proceeding section. Caution: Do not extend the connector by more than 1 cm from the device body.
4. If the adaptor is dirt, disconnect the adaptor by loosening the appropriate screws.
- 4a. Push the nylon brush through the adaptor casing several times and then blow clean with rubber bellows or compressed air. Rub the outer casing and fiber adaptor with a cleaning cloth, if necessary.
- 4b. Install adaptor in the device again and close the device.

4.2 Power-Up Sequence

- Be sure that the ES10 is put into operation under the specified environmental conditions. Avoid temperature shocks after transportation and allow sufficient time to accommodate with the environmental conditions at the operating site.
- If not already realized install the appropriate power supply + fan modules, respectively fan-only modules.
- Connect the ES10 to one or two (in case of redundant power supplies) appropriate power supply lines. If only one power supply cable (instead of two) is connected to an ES10 equipped with redundant power supplies, an alarm will be generated and shown with a yellow illuminated MODULE LED.
- After start (with appropriate power line connections), the MODULE LED is illuminated green and the LCD illumination is on. Then the LCD illumination is switched off and all front side LED's are lightening yellow for a short time indicating an ongoing LED test. Afterwards all LEDs should be lightening green and the microcontroller starts to test the laser and optical modulator. During this test, which takes about 70 seconds, the optical output power on both outputs varies between zero power and about twice the nominal power ($P_{\text{outnom}} + 3 \text{ dB}$).
- With no RF input signal applied and the CSO control loop in "channel controlled" mode the output power may vary about $\pm 1 \text{ dB}$ on both outputs. This behavior is due to the control mode, which adjusts the bias point of the modulator. The output power will be stabilized with an appropriate RF input signal applied or if the CSO regulation mode is changed to pilot controlled.
- After this procedure the LEDs should monitor the status of the transmitter.

4.3 Operating Conditions

4.3.1 Optical output signal

Connect a fiber optic cable with an appropriate, cleaned connector to one of the optical outputs in order to feed an HFC network. Keep in mind that the ES10 is a laser class 1M product according to IEC 60825, which requires adequate safety precautions to avoid hazard to people working with the transmitter.

4.3.2 Applying an appropriate RF input signal

For proper operation, an appropriate RF input signal within the specifications as given in this section has to be applied to the RF input port (CATV port).

The optical transmitter ES10 has a built-in RF power meter function, which monitors the total rms (root-mean-square) level at the input of the transmitter. This rms level has to be in a certain range, so that the transmitter can be properly adjusted. The rms level range depends on the type of ES10 and is given in Table 2.

ES10XL Version	Total OMI OMI_{totrms}	RMS Level Range P_{rms}	P_{VSB} Level Range (unmodulated)	P_{VSB} Level Range (modulated)
PFQ344044 (34 PAL, 40 FM, 44 256QAM)	18.0 %	-16 ... +2 dBm	74 ... 92 dB μ V	76 ... 94 dB μ V

N77 (77 PAL)	18.6 %	-16 ... +2 dBm	74 ... 92 dBμV	78 ... 96 dBμV
C42 (42 PAL)	18.8 %	-16 ... +2 dBm	76 ... 94 dBμV	80 ... 98 dBμV
PAL84 (84 PAL)	19.4 %	-16 ... +2 dBm	74 ... 92 dBμV	78 ... 96 dBμV

Table 2. ES10XL RF input leveling

This rms level P_{rms} depends on the number of AM-TV, FM-radio and QAM carriers and their individual leveling at ES10 RF input port. It can be calculated, when the number of all carriers and their individual carrier levels are known:

$$P_{rms} [dBm] = \frac{P_{VSB} [dBμV] - 108.75}{+ 10 \cdot \log(N_{VSB} \cdot 10^{L_{VSB}/10dB} + N_{FM} \cdot 10^{L_{FM}/10dB} + N_{64QAM} \cdot 10^{L_{64QAM}/10dB} + N_{256QAM} \cdot 10^{L_{256QAM}/10dB})}$$

Where:

- P_{VSB} is the level of the analogue TV carriers (in dBμV)
- N_{VSB} is the number of analogue TV carriers
- L_{VSB} is 0 dB for unmodulated carriers (test) and -4 dB for modulated carriers (real video)
- N_{FM} is the number of audio-radio carriers
- L_{FM} is the audio-radio level referred to the level of the analogue TV carriers (e.g. $L_{FM} = -4$ dB)
- N_{64QAM} is the number of 64QAM modulated carriers (digital TV, Fast Internet)
- L_{64QAM} is the 64QAM carrier level referred to the level of the analogue TV carriers (e.g. $L_{64QAM} = -10$ dB)
- N_{256QAM} is the number of 256QAM modulated carriers (digital TV, Fast Internet)
- L_{256QAM} is the 256QAM carrier level referred to the level of the analogue TV carrier (e.g. $L_{256QAM} = -4$ dB)

Examples:

1. C42 test signal (unmodulated carriers, common European test scenario):
 $N_{VSB} = 42$, $P_{VSB} = 80$ dBμV, $N_{VSB} = 0$ dB: $P_{rms} = -12.5$ dBm
2. C42 real video signal (modulated carriers):
 $N_{VSB} = 42$, $P_{VSB} = 80$ dBμV, $N_{VSB} = -4$ dB: $P_{rms} = -16.5$ dBm
3. N77 test signal (unmodulated carriers, common Japanese/US test scenario):
 $N_{VSB} = 77$, $P_{VSB} = 80$ dBμV, $N_{VSB} = 0$ dB: $P_{rms} = -9.9$ dBm
4. PFQ344044 real video signal (modulated carriers):
 $N_{VSB} = 34$, $P_{VSB} = 80$ dBμV, $L_{VSB} = -4$ dB, $N_{256QAM} = 44$, $L_{256QAM} = -4$ dB, $N_{FM} = 40$, $L_{FM} = -4$ dB:
 $P_{rms} = -12.0$ dBm

4.3.3 AGC Modes

The built-in RF power meter controls the rms input level and indicates its status at the INPUT LED. There are two RF modes, which can be selected.

4.3.3.1 RF Mode “AGC-on”

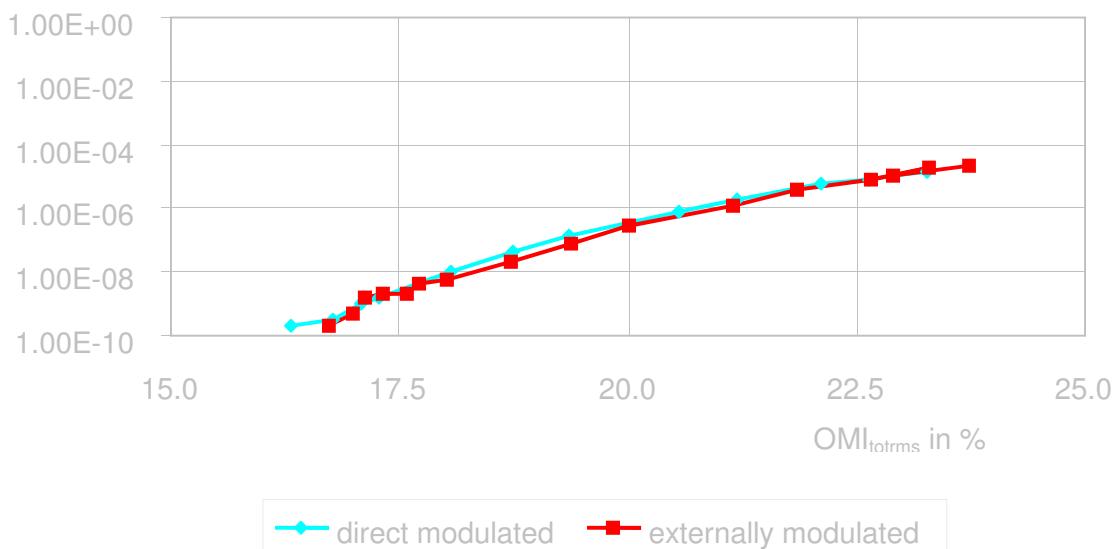
This mode is the recommended mode for standard operation. As long as the input level is within the working range of the transmitter (specified in **Fehler! Verweisquelle konnte nicht gefunden werden.**), the transmitter will itself adjust the optimum gain. Then, the specified total rms modulation index OMI_{totrms} , will be automatically obtained by the AGC.

If the input power is lower or higher than required (outside the specified range) the input LED lights yellow and a warning is generated. If the input power is missing or very high, the input LED lights red and an alarm is generated.

The AGC always tries to maintain the requested optical modulation index as described. This index should be high in order to result in good noise behavior. Yet, too high modulation index causes bit errors, which come up due to overmodulation (clipping) of the transmitter. Therefore, an optimum optical modulation index has to be used, which is given in **Fehler! Verweisquelle konnte nicht gefunden werden.** The ES10 is factory adjusted to achieve a BER of at least 10^{-9} with most frequency plans using the built in AGC function.

Note:

The subsequent diagram shows the relationship between OMI_{totrms} and the bit error rate (BER) measured for 64QAM transmission. Obviously, OMI_{totrms} should be below about 20% in order to obtain BERs better than 10^{-6} .



The BER also depends on the mix of AM, FM and QAM channels. If the QAM load is very small compared to the AM and FM load the OMI_{totrms} might be chosen about 1 dB higher while still obtaining the BER as given in the diagram.

4.3.3.2 RF Mode “AGC-off”

In this mode, which is for experienced users only, the user has the flexibility to change the gain of the internal RF amplifier by -12 ... +5 dB according to his individual requirements. However, this adjustment is changing the RF input sensitivity. The $OMI_{\text{to trms}}$ is measured for the applied input signal and the selected gain and can be monitored on the LCD display or via the Ethernet interface.

This mode should only be used with great care since the automatic protection against overmodulation as given in the AGC-on mode is lost.

4.3.4 Adjusting Regulation Mode

There are two kinds of bias point regulations: “Channel controlled” and “Pilot controlled”.

Operating the transmitter in “channel controlled” mode requires an input signal in order to adjust its electrooptical modulator’s bias point. At least 2 RF channels with a channel spacing of 24 MHz or 21 MHz (software adjustable) are required to obtain a stable performance.

In “pilot controlled” mode, an RF input signal is not required for internal bias point adjustment, because the transmitter uses an internal pilot control. The pilot frequency is outside the transmitted RF frequency range in order not to disturb the user’s signals.

4.3.5 ITU Frequency Adjustments in DWDM Applications (XL only)

The ES10 offers the feature to tune the optical frequency (respectively wavelength) of the transmitter by +/-100 GHz in steps of 50 GHz in order to enable DWDM applications.

The tuning can be performed via the buttons on the front panel or via the Ethernet interface.

4.3.6 Optical Power On /Off

The optical power on/off switching can be performed via the buttons on the front panel or via the Ethernet interface.

The transmitter can also be configured as a back-up transmitter with optical output power off. This allows turning on the transmitter within less than 10 seconds in situations when a fast switching to a redundant transmitter is requested.

4.3.7 SBS suppression setting (XL only)

SBS (Stimulated Brillouin Scattering) is a well-known problem in long distance, high power transmission on optical fibers destroying the CNR and CSO performance especially in the lower transmission frequency band.

For extremely coherent optical light, SBS occurs already at optical powers of around +6 dBm (4 mW) in standard single mode fibers. With electronic methods the coherency of the light can be degraded and in this way achieving an increase of the SBS threshold (meaning the optical power level at which the perturbing SBS effects start to occur).

If the SBS threshold is increased, another effect, the SPM (self phase modulation) can arise. This effect degrades the CSO performance in the higher frequency band. SPM depends on the total dispersion which is present in the transmission system.

SBS and SPM are both nonlinear effects in optical fibers and depend on

- the launched optical power
- the fiber properties (especially fiber loss and mode field diameter)
- the link properties (number of splices and total splice loss)

Both effects are getting worse with

- higher optical power
- lower mode field fiber diameter
- higher quality, lower loss fiber
- fewer, lower loss splices

BKtel is testing the SBS and SPM performance of the ES10 with different fiber types and fiber lengths under worst case conditions: Links containing no splices and providing a fiber loss of only 0.19 dB/km. For this test arrangement the SBS suppression is specified keeping in mind the SPM problems.

4.3.7.1 SBS Threshold

Depending on fiber type and fiber length the achievable SBS threshold of the ES10 varies as shown in the following table.

Fiber Type \ Fiber Length	Max. SBS Threshold Level			
	10km	25km	40km	65km
Standard Fiber (G.652D)	23	21	20	19
SBS Threshold enhanced Fiber*	25.5	23.5	22.5	21.5

*e.g. the Corning NexCor[®] fiber. For more information see: Joint presentation, Corning and BKtel at 2006 SODC Symposium, NexCor[®] Technology for Improved HFC and FTTH Access Networks

The ES10 allows inserting values for fiber type and fiber length of the individual application and link characteristic. The NEC application software then delivers the SBS threshold range which can be achieved with the BKtel suppression technology in this actual case.

4.4 Push Button / LCD Display

Security items

When changing a parameter using the LCD interface in unlocked state, you have to enter a four digit numeric keycode to login. The LCD login times out after 5 minutes with no key pressed.

The factory default keycode is 1111.

NOTE: Changing the keycode to 0000 disables the code and the parameters can be changed without entering a code.

Keys default usage

ESC key The ESC key is used mainly to cancel operations or to switch back a menu level.

ENTER key The ENTER key is used mainly to execute operations or to enter into a new menu level.

The ▼ ▲ Cursor keys are used to select a menu entry or to toggle between possible parameters.

The ◀ ▶ Cursor keys are used to change letters in a number or a string or to scroll in text screens.

General Note

In the following, the menu structure of the LCD interface is explained. For more details, please see also the following chapter 5, in which all the device indications and device configuration parameters are explained in more detail.

Menu structure

Press ENTER at the Root-Screen to get a menu that contains the NMS server "NEC-E" menu entry first, followed by the transmitter "ES10" and a list of aliasnames of all detected RS485 bus BK devices.

Root-Screen

NMS Server "NEC-E" This menu contains all NMS Server specifics

Transmitter "ES10" This menu contains all transmitter specifics

If further devices are connected to RS485 bus of ES10 device:

Device menu1 (Device's aliasname is shown)

Device #2 (Device's aliasname is shown)

...

NMS Server menus

NMS Server

Alarms / Warnings / Infos	Server status information
IP Settings	Set the IP parameters of the server
Keycode	Change the LCD keycode
Properties	Show server properties like software- and hardware releases
Date & Time	Adjust the server's real time clock
Reset Server	Software reset the server
Rescan RS485	(Re)Search for RS485 devices on the bus
Logout	Logout from LCD and return to Root-Screen

NMS Server->IP Settings

Save Settings	NOTE: Don't forget to Save Settings after a change Save the changed IP parameters; the server gets reset after saving the new data
IP address	Change or show the IP address
Netmask	Change or show the netmask
Default router	Set or show the default router

Optical transmitter device menus

Alarms / Warnings / Infos	Show transmitter's alarm, warning or info messages
---------------------------	--

Settings

SBS Suppression	Change or show the SBS suppression threshold value
SBS Fiber Length	Change or show the SBS fiber length
SBS Fiber Type	Change or show the SBS fiber type
Channel Distance	Change or show the channel distance
OMI	Show OMI_{totrms} , change the OMI_{totrms} for AGC mode
RF Gain	Show RF gain, change RF Gain for manual gain mode, related to the nominal gain for nominal OMI and nominal RF-Input power
Laser Frequency	Change or show the lasers ITU optical frequency (DWDM only)
Slope	Change or show RF slope
AGC Mode	Change or show the AGC mode
Optical Output Power	Change or show optical output power
CSO Regulation Mode	Change or show the CSO regulation mode
I/O Port Mode	Change or show the I/O port mode
Redundancy Mask	Change or show redundancy mask
Redundancy Mode	Change or show redundancy mode

IN LED	nominal input power	LED green
	input power out of nominal operation	LED yellow
	loss of input power	LED red

OUT LED	nominal output power	LED green
	lack of output power	LED yellow
	loss of output power	LED red
	standby – operation	LED dark

Table 3. LED display

MODULE status

Normal operation: MODULE LED green

Non urgent alarms: MODULE LED yellow

- fan 1 or fan 2 failure
- Power supply 1 or power supply 2 failure
- Laser cooler current >90 %. In this case the temperature of the transmitter is too high. Improve thermal heat flow in order to decrease the operating temperature.
- Laser bias current >130%. The laser has degraded.

In case of a fan or power supply failure the power supply/fan unit has to be replaced. BKtel offers fans as regular spare parts, too.

Urgent alarms: MODULE LED red

- Laser cooler current =100 %. In this case the temperature of the transmitter is too high. Improve thermal heat flow in order to decrease the operating temperature.
- Critical failure of SBS circuitry. In this case the device has to be sent back for repair to BKtel.
- Internal failure generated by RF amplifier failure, modulator failure. In this case the device has to be sent back for repair to BKtel.

INPUT status

Normal operation: INPUT LED green

Non urgent alarm: INPUT LED yellow

RF-input low or high

- In AGC mode: AGC is out of range
- In Manual Mode: OMI total rms is out of range

Urgent alarm: INPUT LED red

- RF-input is missing.

OUTPUT status

Normal operation: OUTPUT LED green

Non urgent alarm: OUTPUT LED yellow

- The output power deviates by 3 dB from the adjusted value.
The transmitter is still working but with reduced performance. It has to be sent to BKtel for maintenance.

Urgent alarm: OUTPUT LED red

The output power deviates by 4 dB from the adjusted value. The transmitter is not working according to specification. It has to be sent to BKtel for maintenance.

5 CONTROLLING A NEC

Jointly with the optical transmitter a network element controller NEC is embedded in the 19" housing of the ES10. The NEC allows supervising and controlling the transmitter and other equipment which is connected to the RS485 master interface, using the integrated Ethernet webserver (HTTP) interface. The NEC Ethernet interface has to be connected to a PC either directly via a crossed Ethernet cable or via a LAN. It is important to choose the IP address of the NEC to be compatible with the available LAN IP addresses. The IP address can be changed using the push-buttons and the LCD (please refer to NEC operating manual). In the example below the IP address has been set to be 172.23.41.196.

Alternatively the NEC-E USB interface can be used as an user interface for local management. When the NEC-E USB port is connected to a PC an additional virtual LAN interface becomes available. This new PC LAN interface gets automatically configured by the NEC using DHCP. This USB LAN interface is based on the Remote NDIS (RNDIS) specification from Microsoft.

The NEC-E local management is done by using a webbrowser in the same way as when communicating over the NEC Ethernet interface. The NEC USB virtual LAN interface's IP address is hardcoded to the fixed IP address: **10.10.10.10**. Open a web browser and enter **10.10.10.10** in the address line of the browser.

Please note:

Information regarding the installation of the USB driver and the installation files can be obtained

- from the compact disk delivered with BKtel product
- from BKtel representative (www.bktel.com)

5.1 Communicating with the NEC

If a webbrowser gets in touch with the NEC of the transmitter a webpage as shown below will appear within the webbrowser (e.g. MS Internet Explorer):

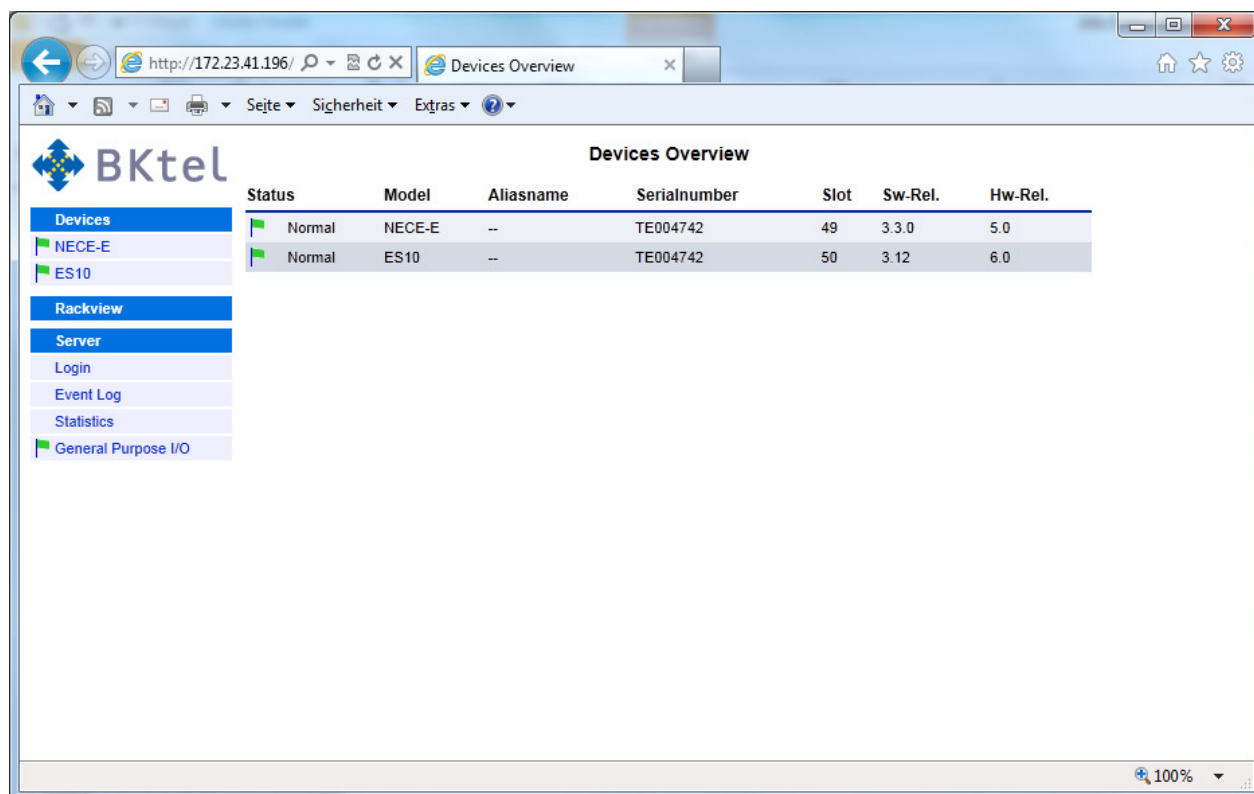


Fig. 5.1.1: Display of Webbrowser (Microsoft I.E.)

Selecting the menu button “Devices” all devices are displayed which are connected and recognized by the NEC. In the example above only one device is connected to the embedded NEC, the **ES10**. The NEC itself is displayed with the name NEC-E. The devices overview window shows general information about the devices. Clicking the name in the devices window selects the specific device for management purposes. For physical location of a device connected to the NEC, the flag in front of the devices name can be used. Clicking this flag initiates the module LED at the device to blink for 10 seconds.

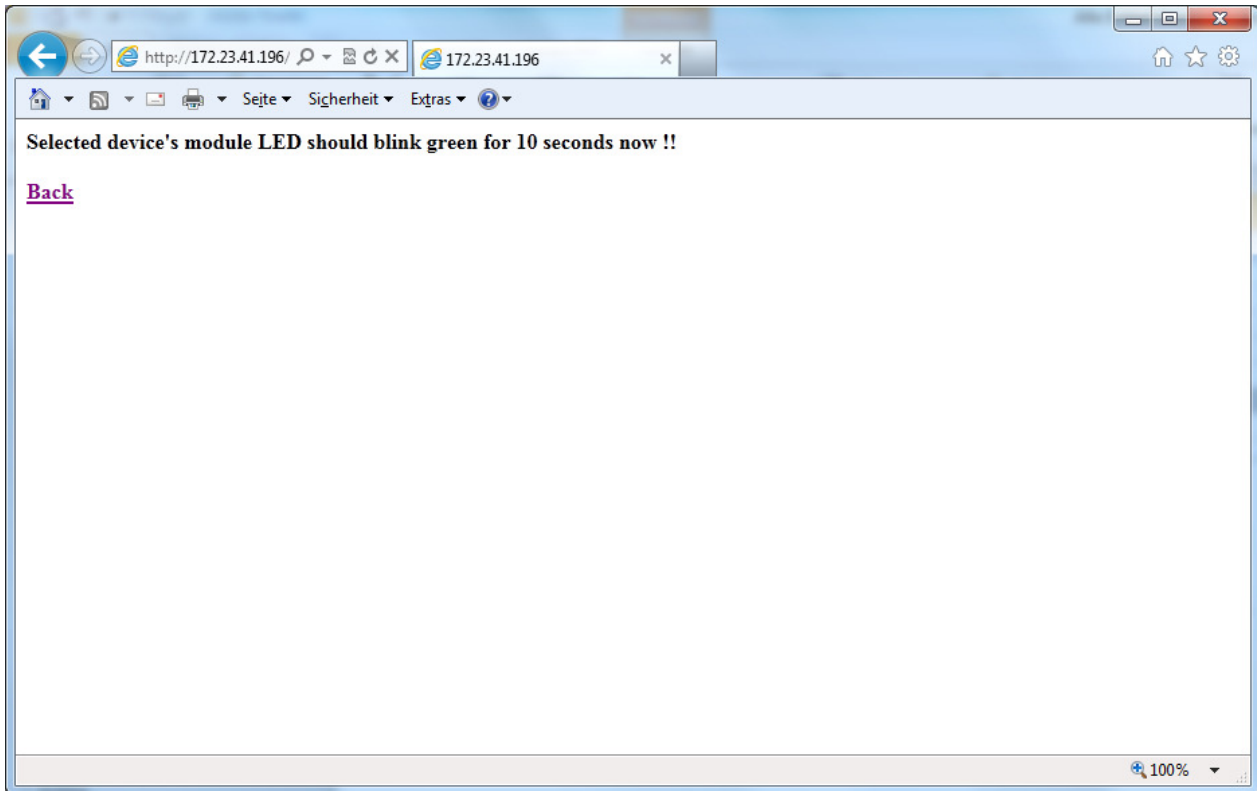


Fig. 5.1.2: Log-in to the NEC (server)

In order to change values within the equipment recognized by the NEC, it is necessary to **login** to the NEC (= server). Otherwise, it will only be possible to view all the values, however, not to change them.

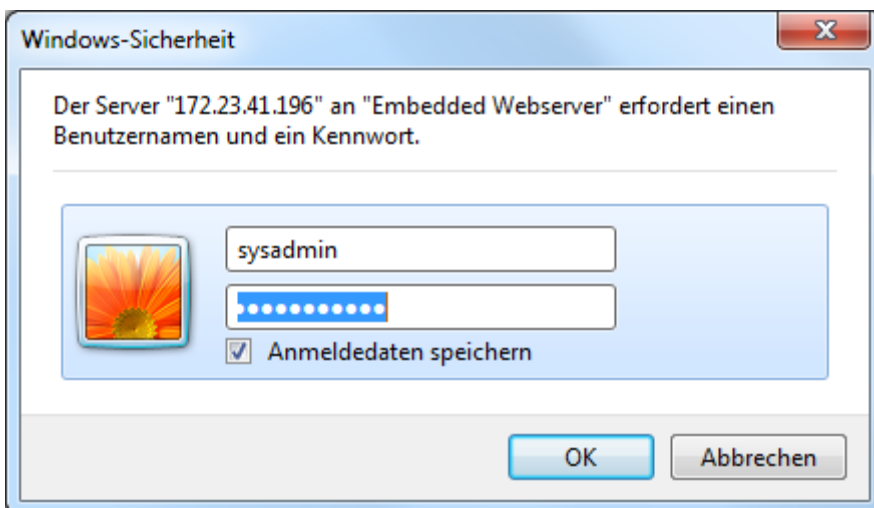


Fig. 5.1.3: Display of login menu

If **login** is selected, it is required to enter the user name and the appropriate password.

Note: The buttons occur in different languages depending on the actual Windows language setting.

After login two additional menu buttons appear in the menu 'Devices': Devices update and Configure Slots. In the main window a button *RescanAll* allows to research the network for newly connected devices. Please note that new BK devices should be automatically detected by the server when inserted into the RS485 bus, but if there are problems then this button might help the server to find all devices.

5.2 Devices Update

Using this menu button an update of the selected devices firmware is possible as can be seen in Fig. 5.2.1.

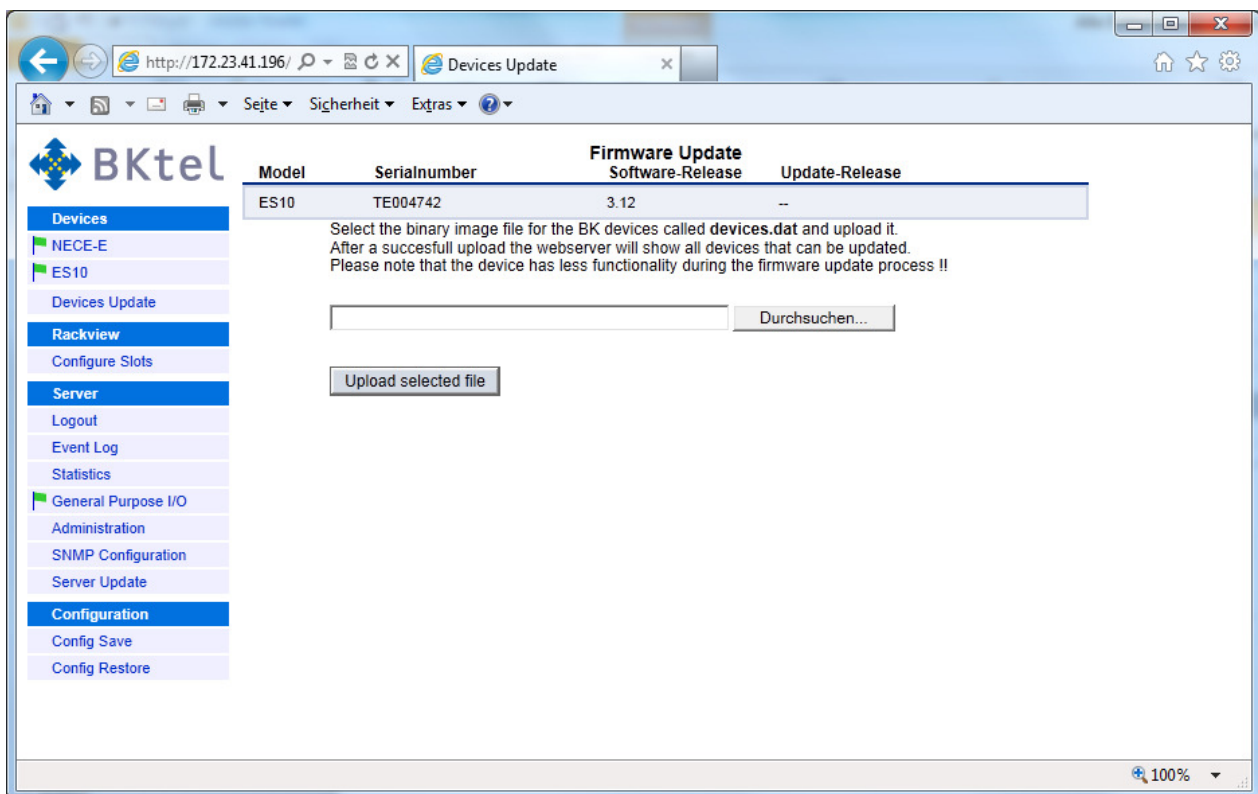
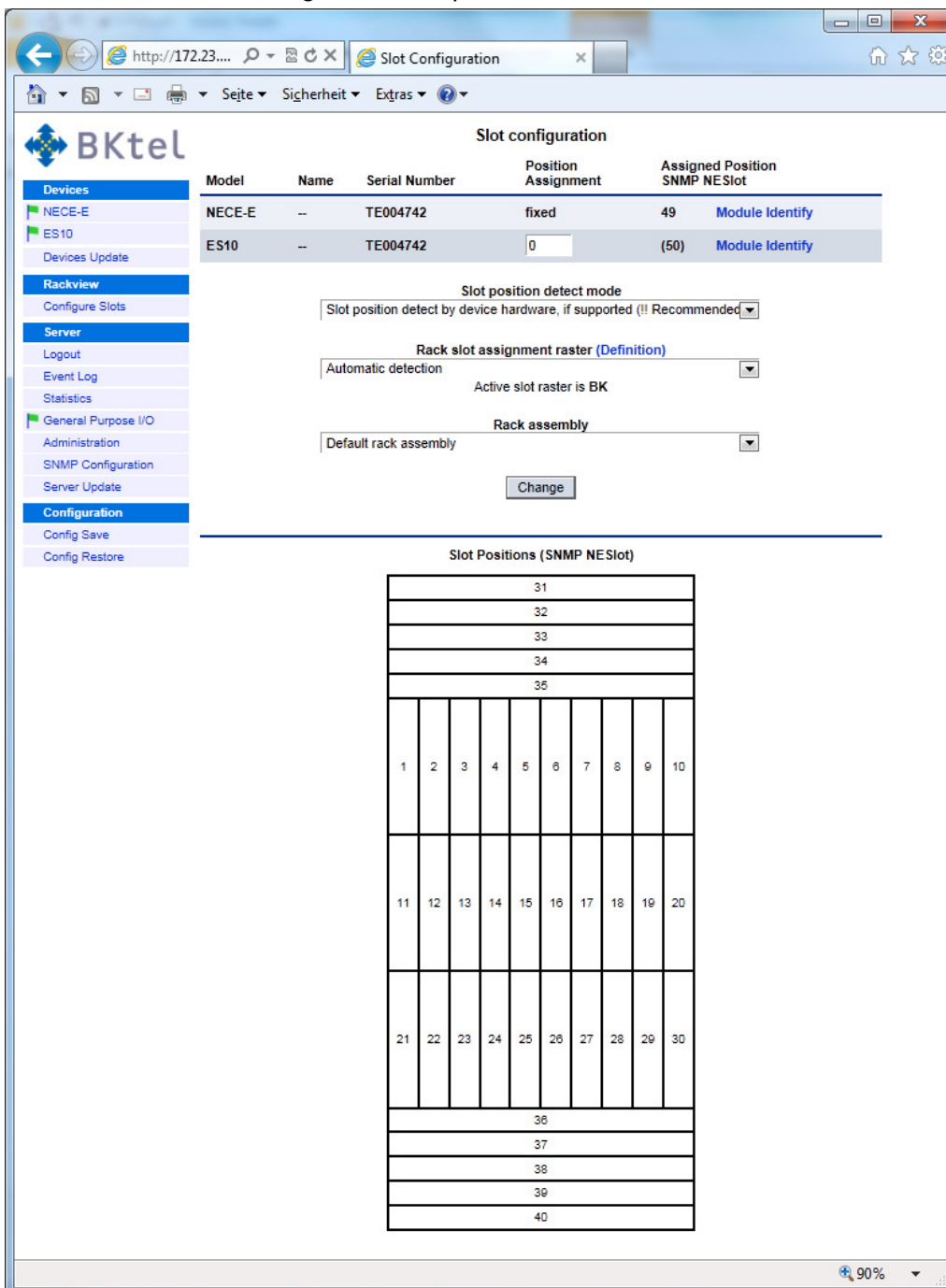


Fig. 5.2.1: Devices Update page

5.3 Configure Slots (optionally)

The Configure Slots page provides the possibility to assign a slot number to the specific device. This functionality is useful if the NEC supervises a larger number of devices especially in the BKtel modular platforms BK Mega and 2G6.

The number range is from 1 to 48. Number 49 is reserved. In case no numbers are assigned number 50 and above are automatically used. In case the device is a BKtel product mounted in a BBT00x subrack, the slot number is detected and assigned automatically. For details see the operational manuals of the BK Mega and 2G6 product series.



Slot configuration

Model	Name	Serial Number	Position Assignment	Assigned Position	SNMP NESlot
NECE-E	--	TE004742	fixed	49	Module Identify
ES10	--	TE004742	0	(50)	Module Identify

Slot position detect mode
 Slot position detect by device hardware, if supported (!! Recommended)

Rack slot assignment raster (Definition)
 Automatic detection

Active slot raster is BK

Rack assembly
 Default rack assembly

[Change](#)

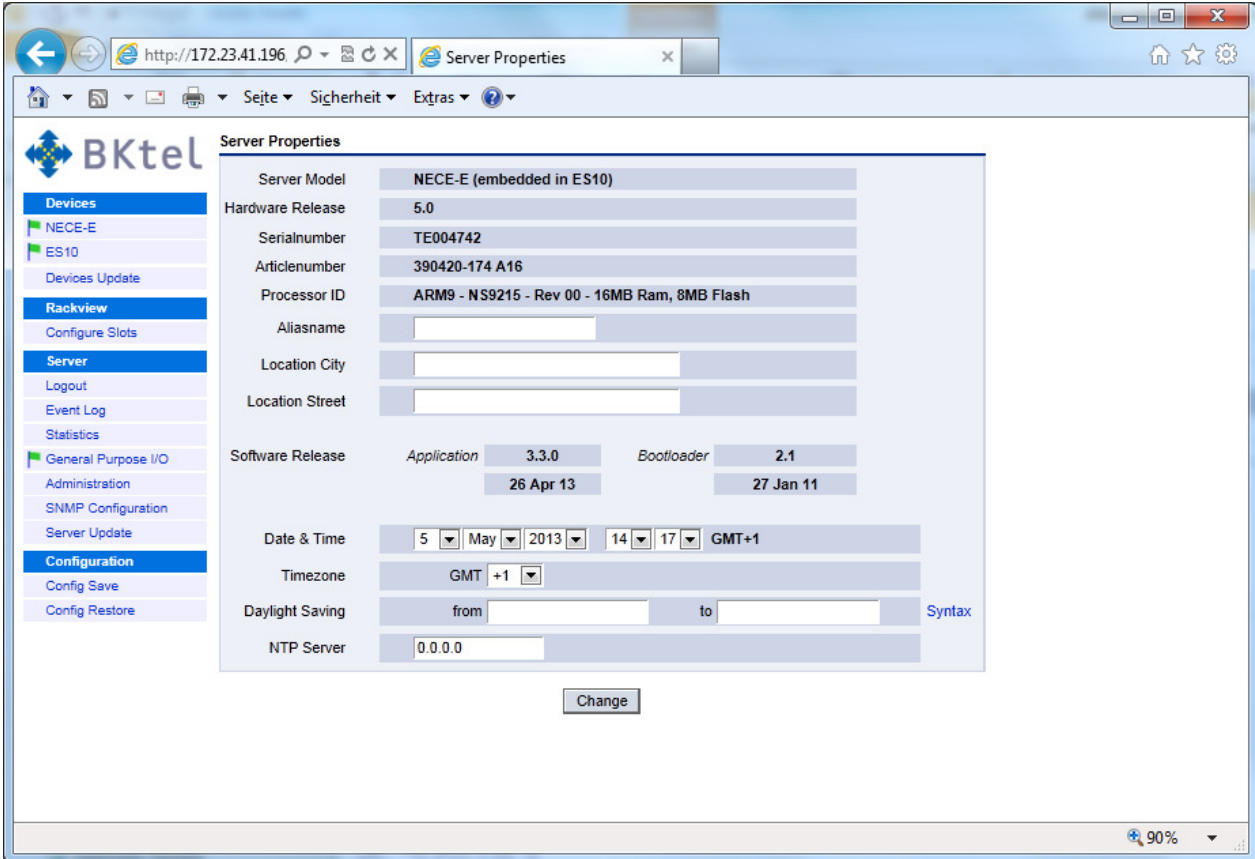
Slot Positions (SNMP NESlot)

31									
32									
33									
34									
35									
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
36									
37									
38									
39									
40									

Fig. 5.3.1: Configure Slots page

5.4 Server Properties

Selecting the menu button 'Server' the properties of the NEC are displayed as shown in the following figure:



Server Properties

Server Model	NECE-E (embedded in ES10)		
Hardware Release	5.0		
Serialnumber	TE004742		
Articlenumber	390420-174 A16		
Processor ID	ARM9 - NS9215 - Rev 00 - 16MB Ram, 8MB Flash		
Aliasname	<input type="text"/>		
Location City	<input type="text"/>		
Location Street	<input type="text"/>		
Software Release	Application	3.3.0	Bootloader 2.1
		26 Apr 13	27 Jan 11
Date & Time	5 May 2013 14:17 GMT+1		
Timezone	GMT +1		
Daylight Saving	from <input type="text"/> to <input type="text"/>		Syntax
NTP Server	0.0.0.0		

[Change](#)

Fig. 5.4.1: Server Properties page

5.5 Event Log

Selecting the Event Log menu button all events which occurred during operation of the NEC are displayed. Depending on the operating conditions the event log looks similar to what is shown in the figure below:

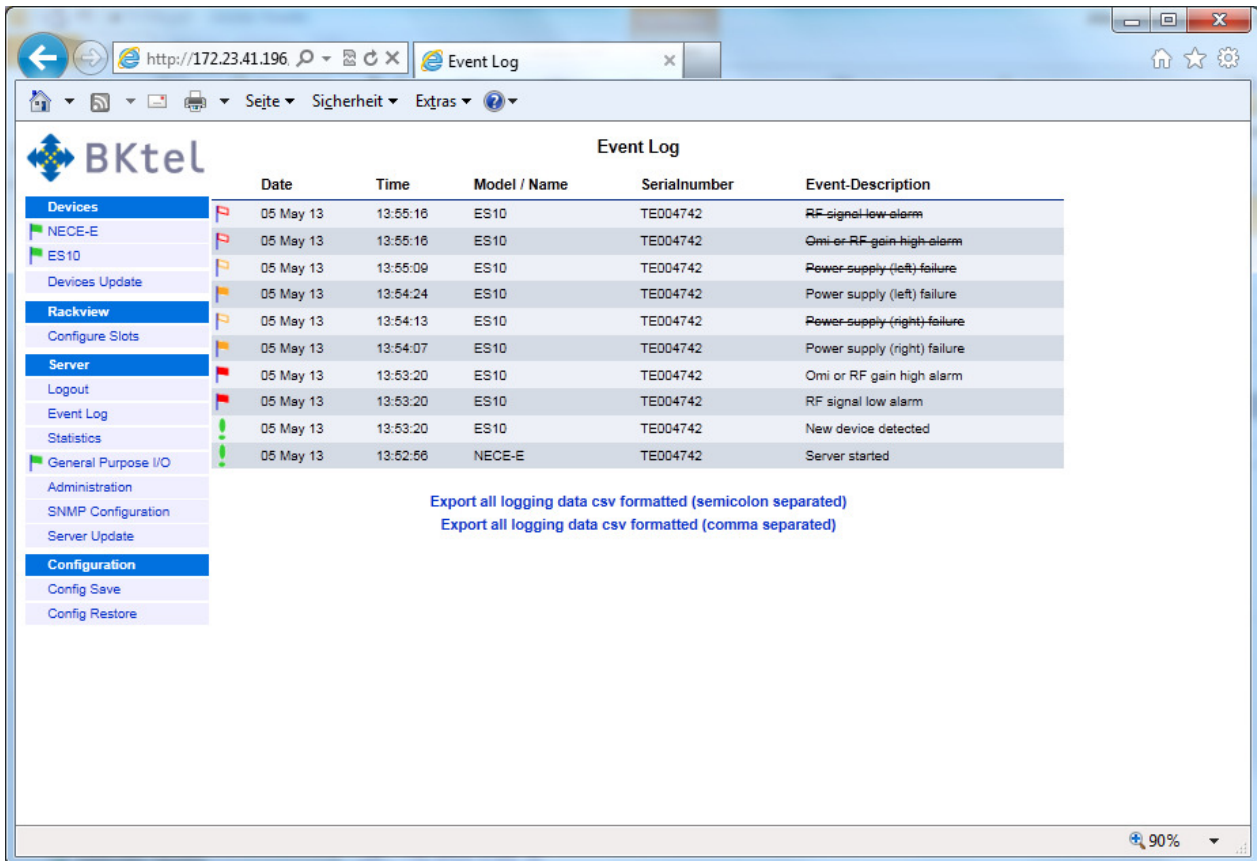


Fig. 5.5.1: Event log page

There are several marks, filled or unfilled, used to show all events.

- Green exclamation marks show events which occur during normal operation. A solid green exclamation mark indicates that the event is still present. An exclamation mark filled with white colour indicates that the event has elapsed. At the same time, the previous shown event with filled exclamation mark is scratched out.
- Red flags show urgent alarms. Filled or unfilled flags have the same meaning described for the exclamation mark.
- Orange flags show warnings. Filled or unfilled flags have again the same meaning described for the exclamation mark.
- All events are shown with time stamps, the equipment causing the event, the serial number of the equipment and a description of the event.

Up to 512 entries in the event log page are displayed. If this number is reached, the oldest entry is deleted in order to provide space for a new entry.

5.6 Statistics

The statistics page allows getting an insight into the trap handling and the performance of the NEC as well as the response performance of the RS484 bus.

The statistics of sent, pending and discarded traps is shown in fields and allows to check, whether the SNMP trap settings are set correctly and/or the communication with the trap receiver works properly.

- **Traps sent:** The number of trap packets, which have been sent by the NEC. Remark: Trap packets are counted, for example: In case of 4 registered trap receivers the counter is increased by 4 for each trap-event
- **Traps pending:** The number of trap packets, which the NEC-E has still to send.
- **Traps discarded:** The number of trap-packets the NEC-E has discarded. The counter is incremented in case of any "discarded" trap, that means in any case of NEC-E trap memory-overflow or not in advance via SNMP Get Request verified traps.

The statistics of RS485 bus responses allows to check, whether the RS485 bus communication works properly. In case of erroneous responses a hardware failure in one of the connected devices is likely. It is recommend to locate the device by sequentially disconnect all devices until the erroneous responses disappear. If the malfunction stays after rest and reconnecting of the device, it is likely to be damaged and has to be sent back to BKtel for repairs.

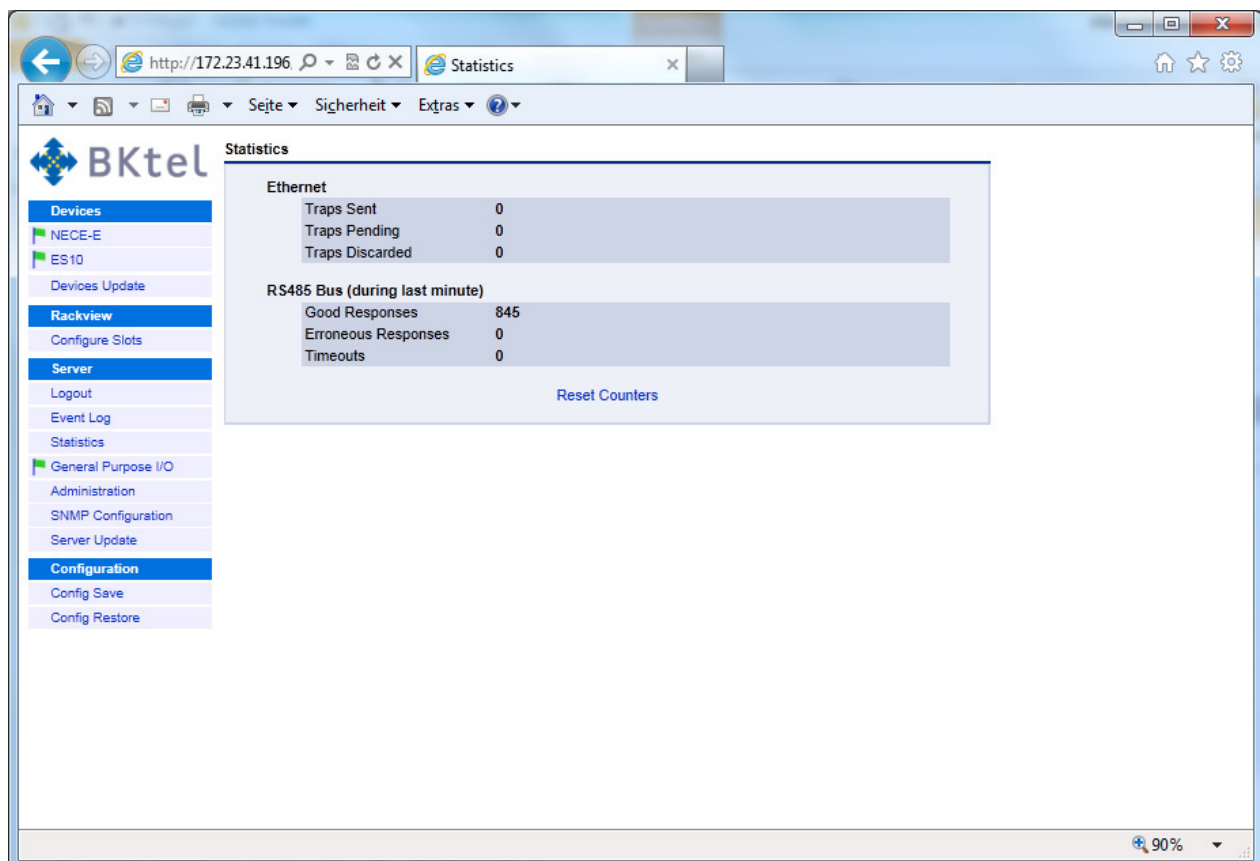


Fig. 5.6.1. Statistics page

5.7 General Purpose I/O Ports of NEC Server (Option)

The NEC-E provides general purpose I/O ports for remote control functions (ref. to 2.3). After selecting this item in the Server Menu, a window as shown below will appear:

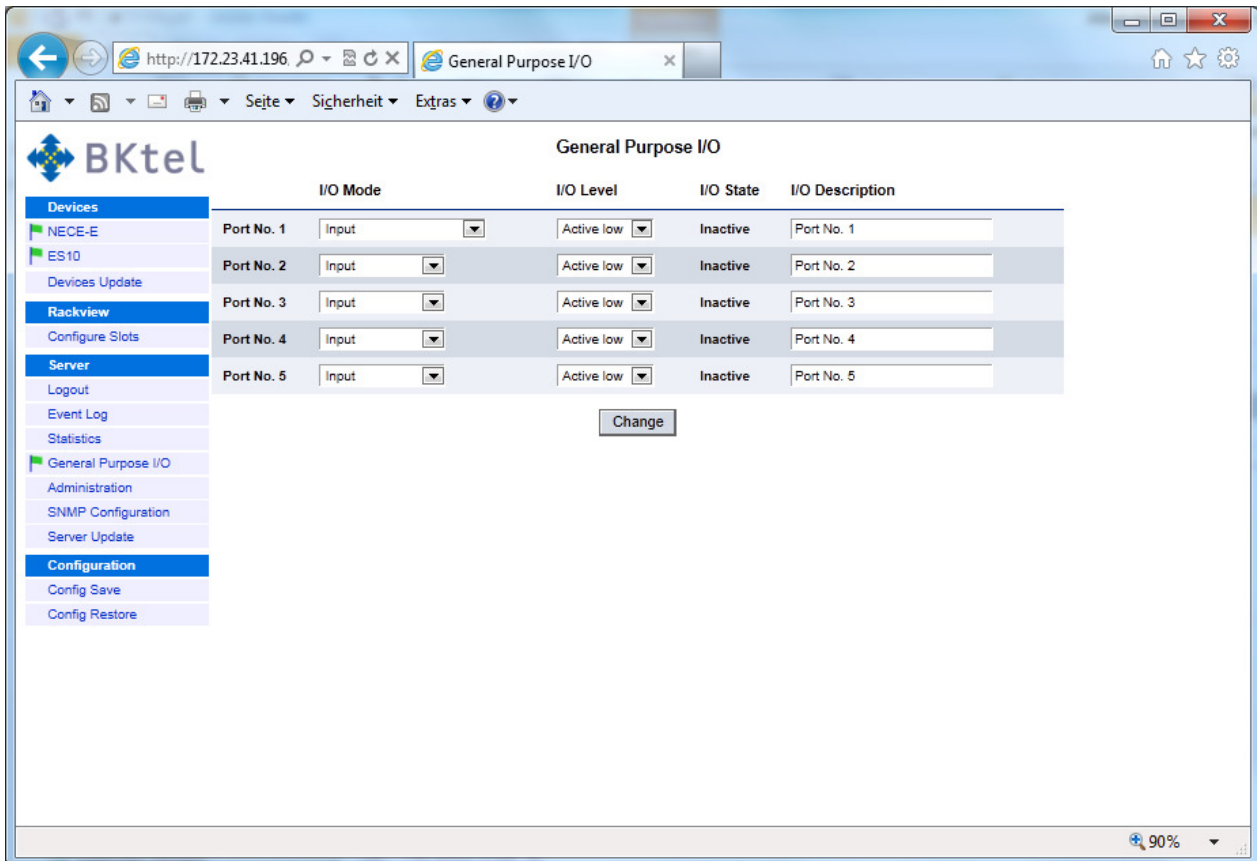


Fig. 5.7.1: Display of I/O ports menu

In the I/O mode column, the mode of both the I/O port and all 4 input-only ports (ref. to 3.4) can be set. The figure below shows the available options for the I/O port:

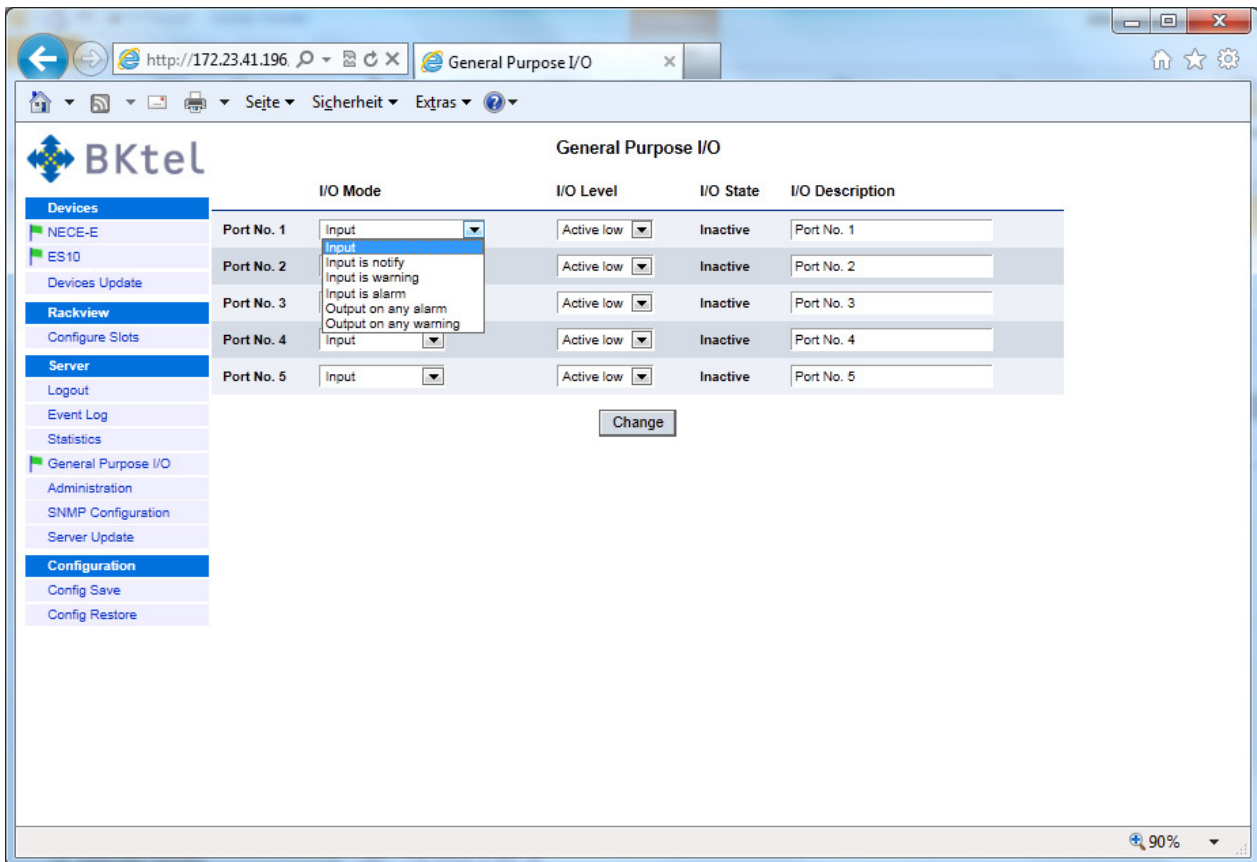


Fig. 5.7.2: Available modes of operation for the I/O port

The options for the input-only ports are shown in the figure below:

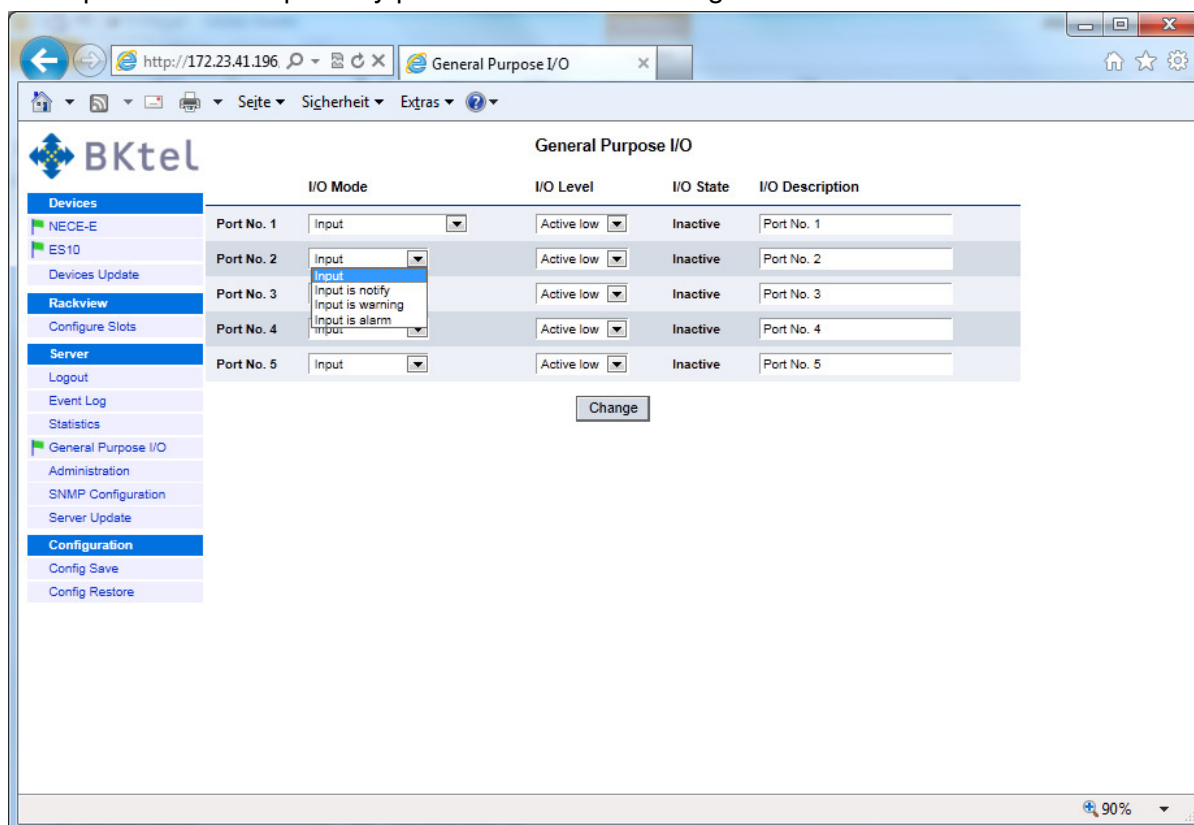


Fig. 5.7.3: Available modes of operation for input ports

The available modes of operation for the I/O ports are given in Table 4:

Port mode	Description	Application (examples)
Input	Input signal (default = factory setting)	Somebody entered the headend (available on ports 1 ... 5)
Input is notify	Input signal creates a notify message (exclamation mark) in status display	Somebody entered the headend (available on ports 1 ... 5)
Input is warning	Input signal creates a warning message (orange flag) in status display	Temperature in room is too high (available on ports 1... 5)
Input is alarm	Input signal creates an alarm message (red flag) in status display	Headend failure (available on ports 1... 5)
Output on any alarm	Output will become active with any alarm. Alarm limits for the ES10 can be set in limits menus of ES10	(available for port 1)
Output on any warning	Output will become active with any warning. Warning limits can be set in limits menus of ES10	(available for port 1)

Table 4. Modes of the I/O ports

All ports can be set to be either active low or active high. A description of the I/O port function can be added to each port optionally

5.7.1 Examples of I/O port status information

An ES10 polls also an EDFA (e.g. OVnxxxxb) via the RS-485 interface.

Please note, that the I/O port #0 is directly related to the transmitter unit (ES10, refer to 2.3) whereas all other I/O ports (#1 ...5) are related to the NEC.

- We assume that **I/O #0 is set to output on any warning** (and alarm)
- We assume that **I/O #1 is set to output on any alarm** (no warnings)

The following table lists the state of I/O #0 and #1 for some alarm situations.

Alarm situation	I/O #0 (output on any warning)	I/O #1 (output on any alarm)
RF input of ES10 is low (warning); OVnxxxxb has no warnings or alarms	Active	Inactive
RF input level of ES10 is extremely low (alarm)	Active	Active
Optical input power level of OVnxxxxb is low (warning); ES10 has no warnings or alarms	Inactive	Inactive
Optical input power level of OVnxxxxb is low (warning); ES10 has no warnings or alarms; I/O #2 is set to alarm on input; I/O #2 receives an alarm	Inactive	Active
Optical input power level of OVnxxxxb is very low (alarm); ES10 has no warnings or alarms	Inactive	Active

5.8 Server Administration

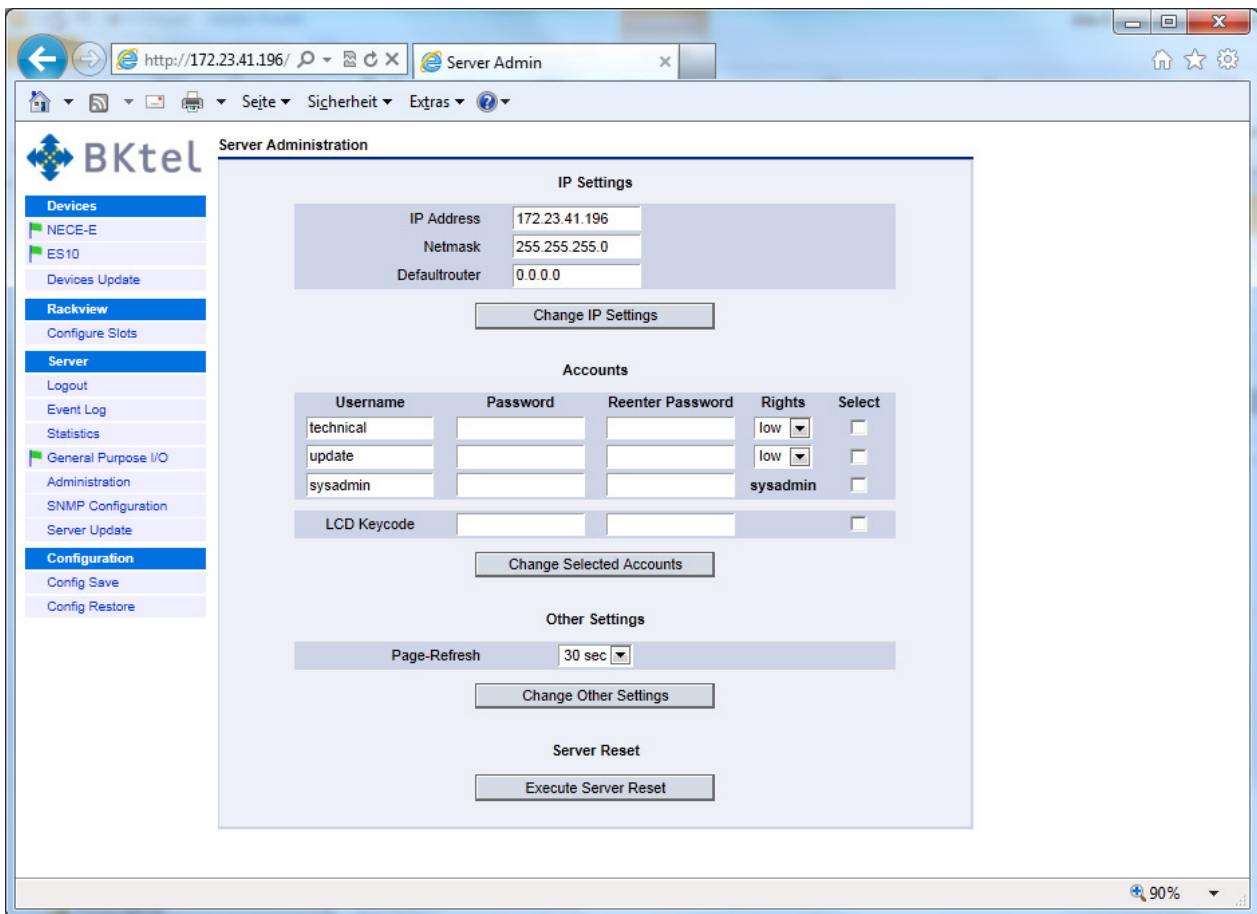


Fig. 5.8.1: Server administration menu

The server administration menu allows modifying the IP parameters, the user names and passwords and the interval, how fast the webbrowser pages are updated.

The update interval has to be chosen carefully, especially if the number of devices polled by the NEC is quite high, in order to avoid too much communication traffic. The new parameters in the different blocks are executed by clicking on the change button of the individual block.

There are three levels of login priorities defined.

Username	Factory Default Password	Description
technical	<i>technical</i>	In this level all parameters are allowed to be changed, except the update and server administration items.
update	<i>update</i>	In this level (additionally to the “technical” level) the server and device update processes can be executed.
sysadmin	<i>sysadmin</i>	System administrator level, all tasks can be done.

5.9 SNMP Configuration

A SNMP configuration menu is available as shown in the figure below:

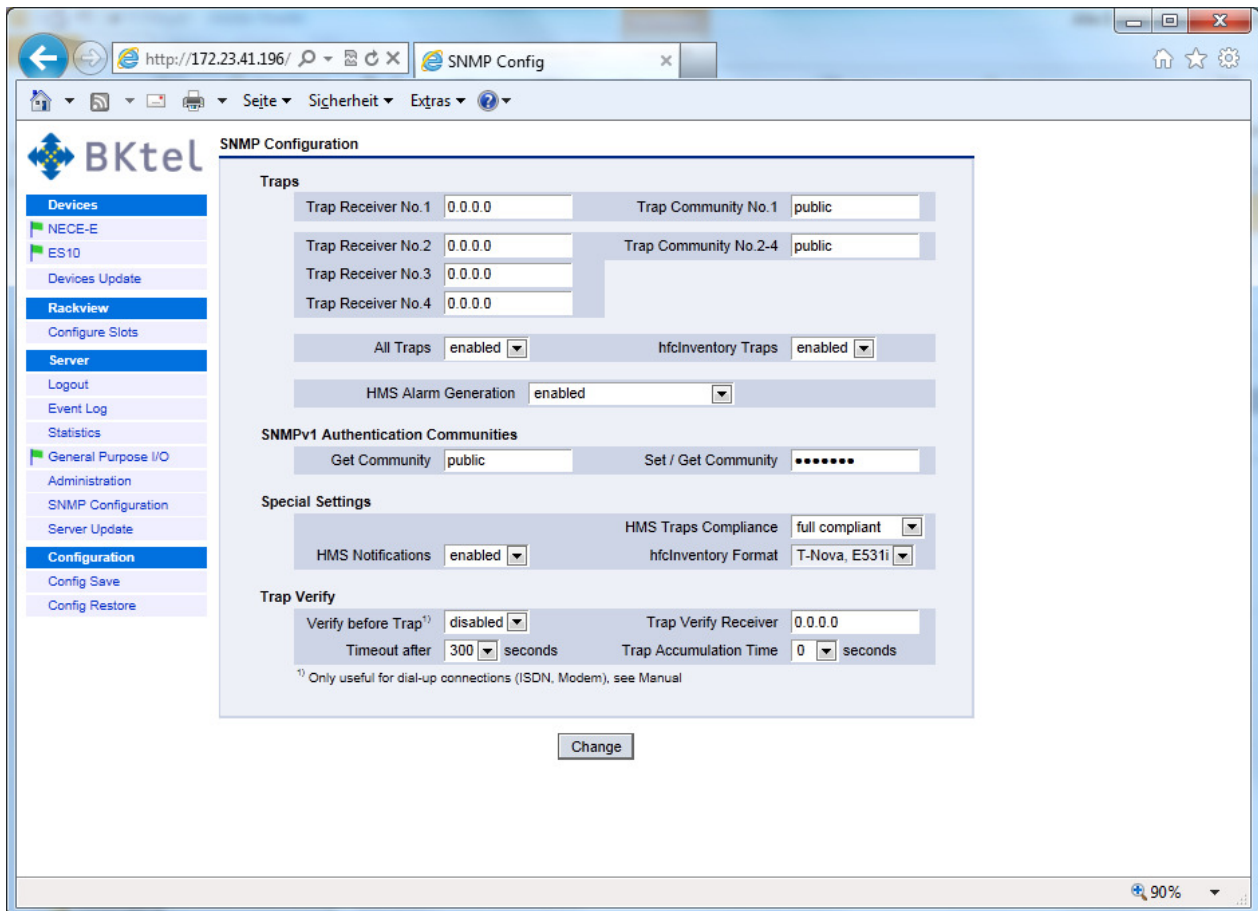


Fig. 5.9.1: SNMP configuration menu

SNMPv1 Authentication Communities

Separate strings can be allocated to the get community and the set/get community.

Special Settings

HMS Traps Compliance	
(see also SCTE-HMS-ALARMS-MIB und SCTE-HMS-COMMON-MIB)	
minor compliant ⁽¹⁾	full compliant
hmsAlarmEvent Trap is sent with ENTERPRISE OID <i>alarmsIdent</i> (1.3.6.1.4.1.5591.1.2), instead of OID <i>scteHmsTree</i> (1.3.6.1.4.1.5591.1) as demanded by HMS MIB	As demanded by HMS MIB, hmsAlarmEvent Trap is sent with ENTERPRISE OID <i>scteHmsTree</i> (1.3.6.1.4.1.5591.1).
hmsColdStart Trap is sent to RFC1215 with ENTERPRISE OID <i>commonIdent</i> (1.3.6.1.4.1.5591.1.3), instead of OID <i>scteHmsTree</i> (1.3.6.1.4.1.5591.1) as demanded by HMS MIB and with Trap-Type COLD START.	As demanded by HMS MIB, the hmsColdStart Trap is sent with the ENTERPRISE OID <i>scteHmsTree</i> (1.3.6.1.4.1.5591.1) and with Trap-Type ENTERPRISE SPECIFIC + Specific-Trap-Type 0.

HMS Notifications	
enabled ⁽¹⁾	disabled
All messages of type "Notification" are sent as Trap and are inserted in the SNMP SCTE HMS tables. Since HMS does not recognize Notifications, "HMS-Severity" <i>minor</i> is reported	All messages of type "Notification" are not sent as Trap and are not inserted in the SNMP SCTE HMS tables. In the webbrowser the Notifications are still shown

hfcInventory Format	
T-Nova, E531i ⁽¹⁾	DKS, T12-9
The SNMP variable "hfcInventoryFabricData" of the T-NOVA-HFC-INVENTORY-MIB is provided in the format defined by Biedenbach (T-Nova, E531i)	The SNMP variable "hfcInventoryFabricData" of the T-NOVA-HFC-INVENTORY-MIB is provided in the format defined by Herberg (DKS, T12-9)

Trap Verify

If traps are to be transmitted via non-permanent links like dial-up links (e.g. using ISDN or standard analog modem), it is important to verify that the link to the trap receiver is working before any SNMP traps are sent. Otherwise the traps could get lost.

Several settings have been introduced to obtain a verification of the link between the trap transmitter (=NEC) and trap receiver:

- **Verify before trap.** If enabled, via SNMP Get Request the “sysDescr” OID of the host having the “Trap Verify Receiver” IP address (see below) is executed before the pending traps are sent. Only after successful reply all pending traps are sent. For permanent-on links (e.g. LANs), “disabled” is the recommended setting. For other links “enabled” is the recommended setting.
- **Trap verify receiver:** Here the IP address of the receiver, verifying the link, can be entered. In many cases it might be one of the trap receiver addresses as entered. However, in dial-up links, optionally the IP address of a receiving modem (e.g. ISDN router) could be used instead of the IP address of a real trap receiver.
- **Timeout:** A timeout time between 30 and 600 seconds might be specified, in order to detect a link error. The NEC-E is waiting the specified time for replies on the “sysDescr” SNMP Get Requests. After this time all pending traps are sent, regardless if a reply has arrived or not. Important: In this case of timeout the ‘traps sent’ and the “traps discarded” counter (see below) are incremented.
- **Trap Accumulation Time:** It is possible to collect traps during the “*Trap accumulation time*”, which can be set between 0 and 60 seconds, until they are transmitted 63ight63ad63e. This feature helps to reduce connection fees in dial up connections. In the following cases the accumulated traps are in any case released for sending:
The internal trap memory is 3/4 filled.
The SNMP agent of the NEC-E is polled by any kind of manager.
- **Test “trap verify receiver” response:** This function is very useful to set up and test the communication in modem links. By clicking this link it can be tested, whether the “Trap Verify Receiver” is answering correctly on the SNMP Get Request. (Timeout after 30 seconds). This link is only visible, when “Verify before Trap” is enabled.

5.10 Server Update

It is possible to update the Server (=NEC) firmware by uploading it to the optical transmitter using the Webserver software upload menu as shown below.

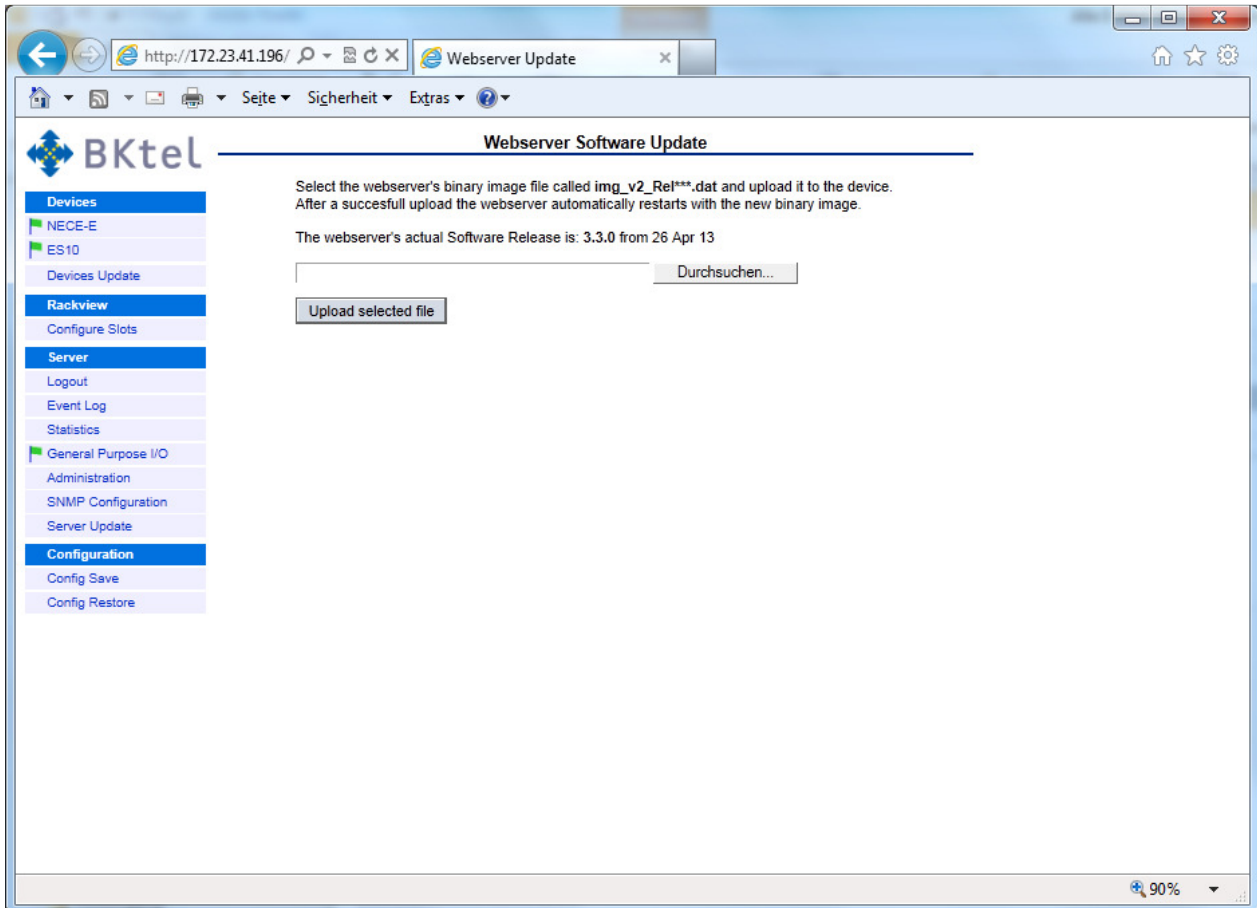


Fig. 5.10.1: Server update menu

A server software update might be required, if new equipment has to be supervised by the NEC, connected to the RS485 (master) interface, or if the changes to the webbrowser- or SNMP-Ethernet interfaces have to be implemented.

Note: The buttons occur in different languages depending on the actual Windows language setting.

5.11 Config Save

A configuration menu is optionally available. The menu allows the user to save and/or to restore the configuration settings of the equipment controlled by the NEC. Pushing the 'Config Save' button the following figure appears.

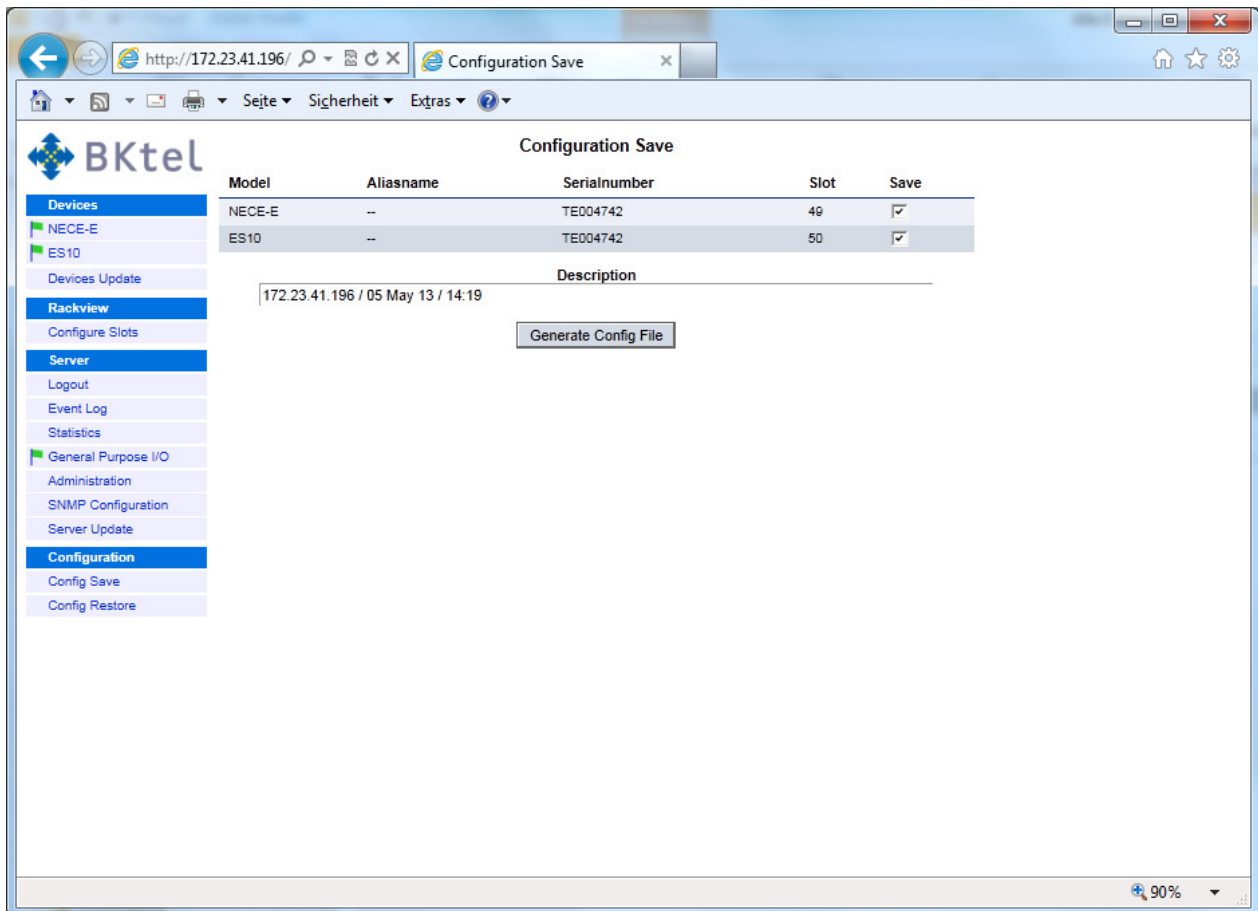


Fig. 5.11.1: Config save menu

A table of the controlled devices with model name, alias name, serial number and slotnumber is displayed. Devices can be marked for configuration saving using last column of the table.

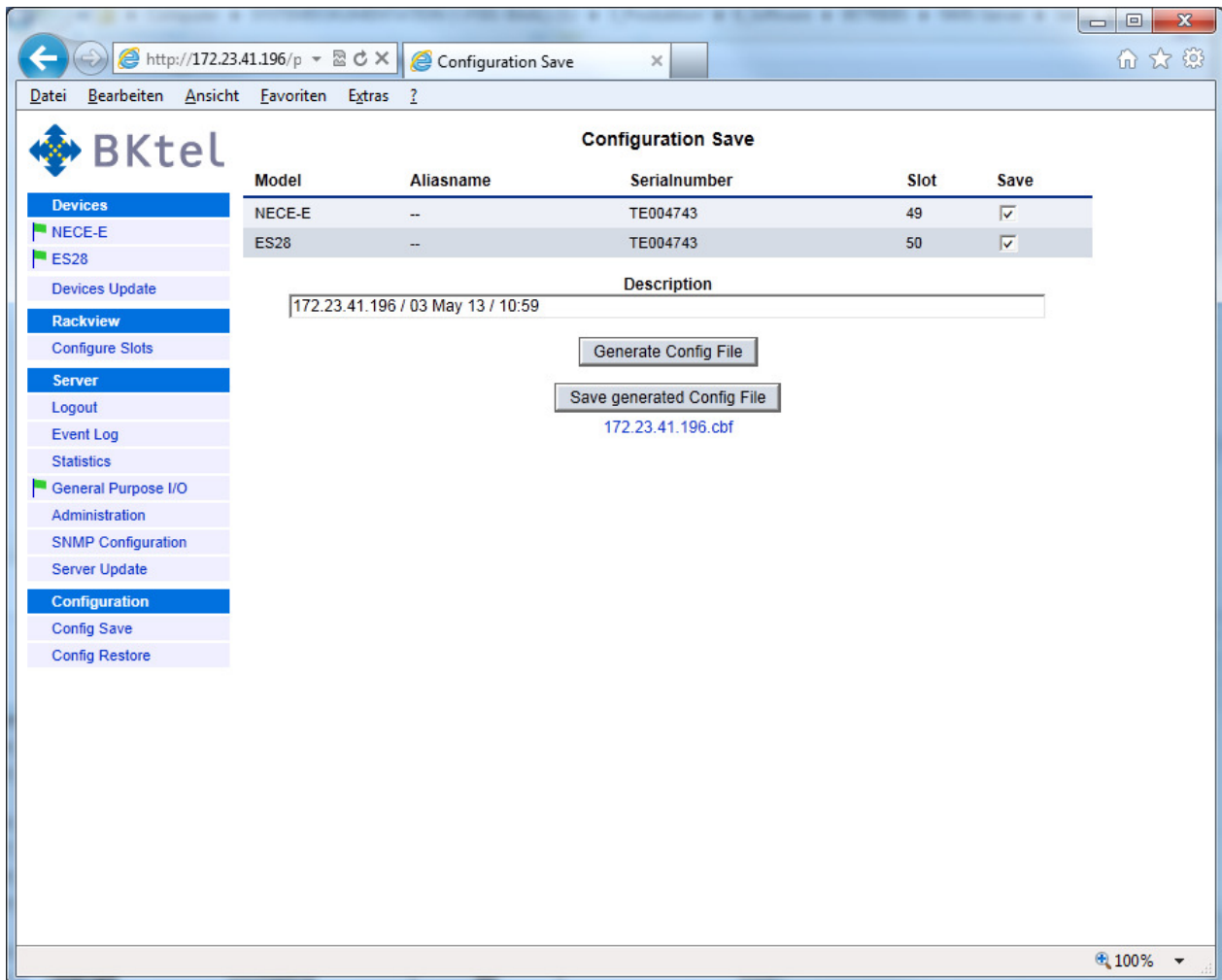


Fig. 5.11.2: Config Save page

Pressing the 'Generate Config file' button a file with the settings of the selected devices is generated and stored in the flash memory of the NEC. To save the file locally, the button 'Save generated Config file' can be used. The default file name is displayed below the button. Also this link can be used to initiate the file storage.

5.12 Config Restore

Pushing the 'Config Restore' button the file saved in the NEC memory is available for restoring as shown in the figure below.

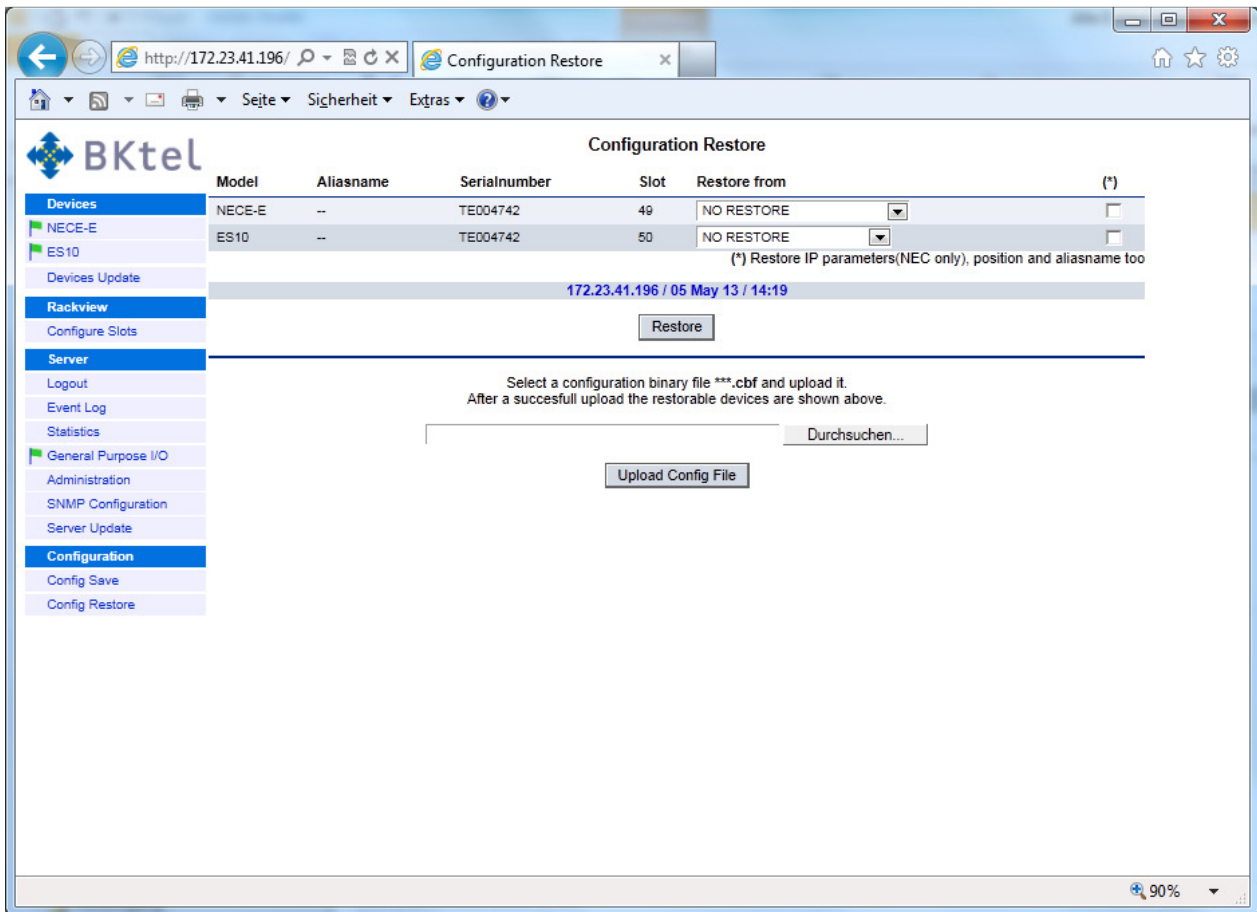


Fig. 5.12.1: Config Restore page

In the column 'Restore from' the available configurations can be selected by model name, alias name, serial number and slot number. The 'Restore' button starts the restoration.

In the last column it can be selected if the equipment should also take over the aliasname and slotnumber. In this way the device can be completely recovered in its settings. In this manner it is easy to configure a replacement unit or restore the configuration of an entire group of devices e.g. after a system crash.

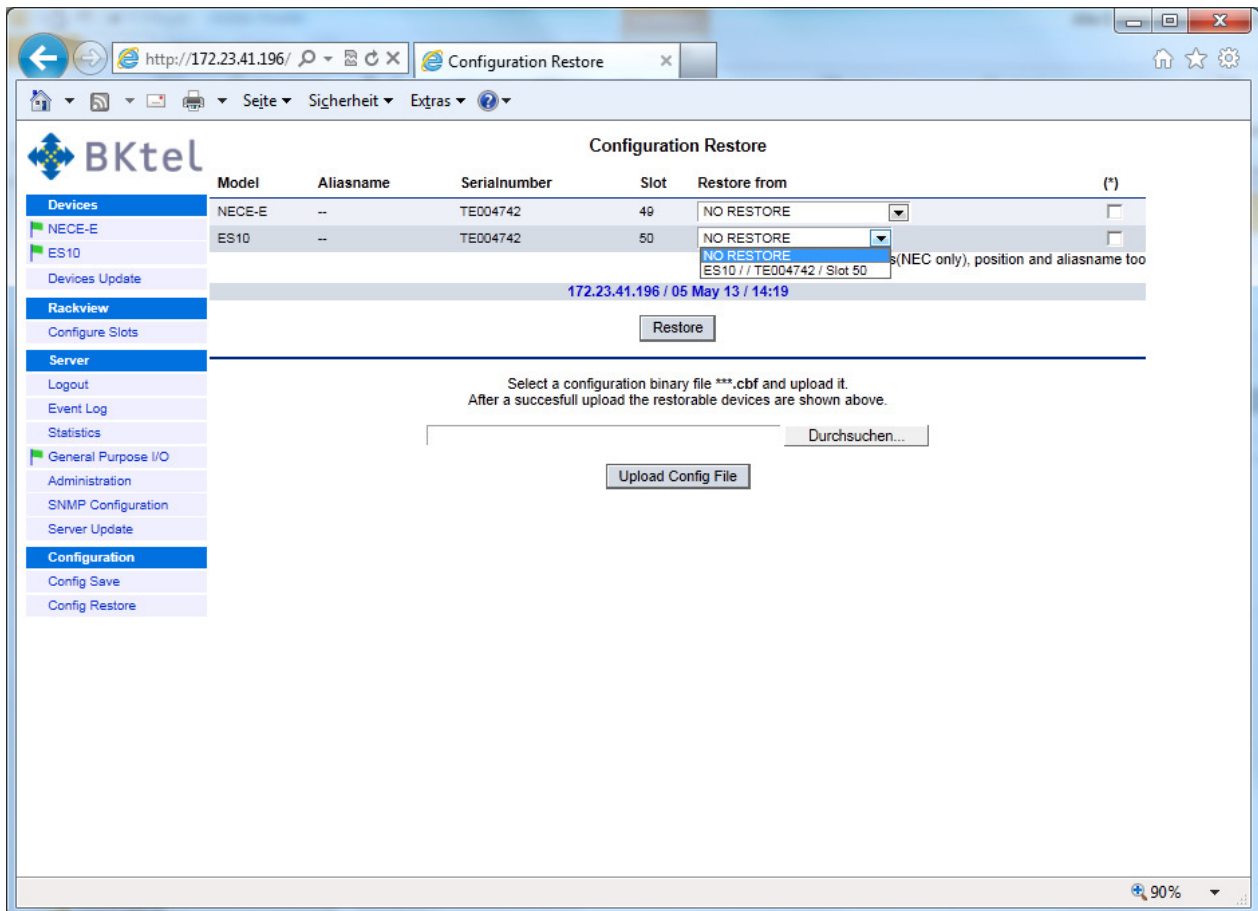


Fig. 5.12.2: Config restore menu

In case configuration settings of a device should be transferred to another device e.g. in a different system, the mark has to be deselected. Only the configuration settings are then applied, the aliasname and slotnumber of the device is not altered.

Using the 'Upload Config file' button a local file can be loaded into the NEC memory and further on be used for restoring configuration settings as described.

6 CONTROLLING ES10 VIA A NEC

6.1 Status

The figure below shows the status page of the ES10.

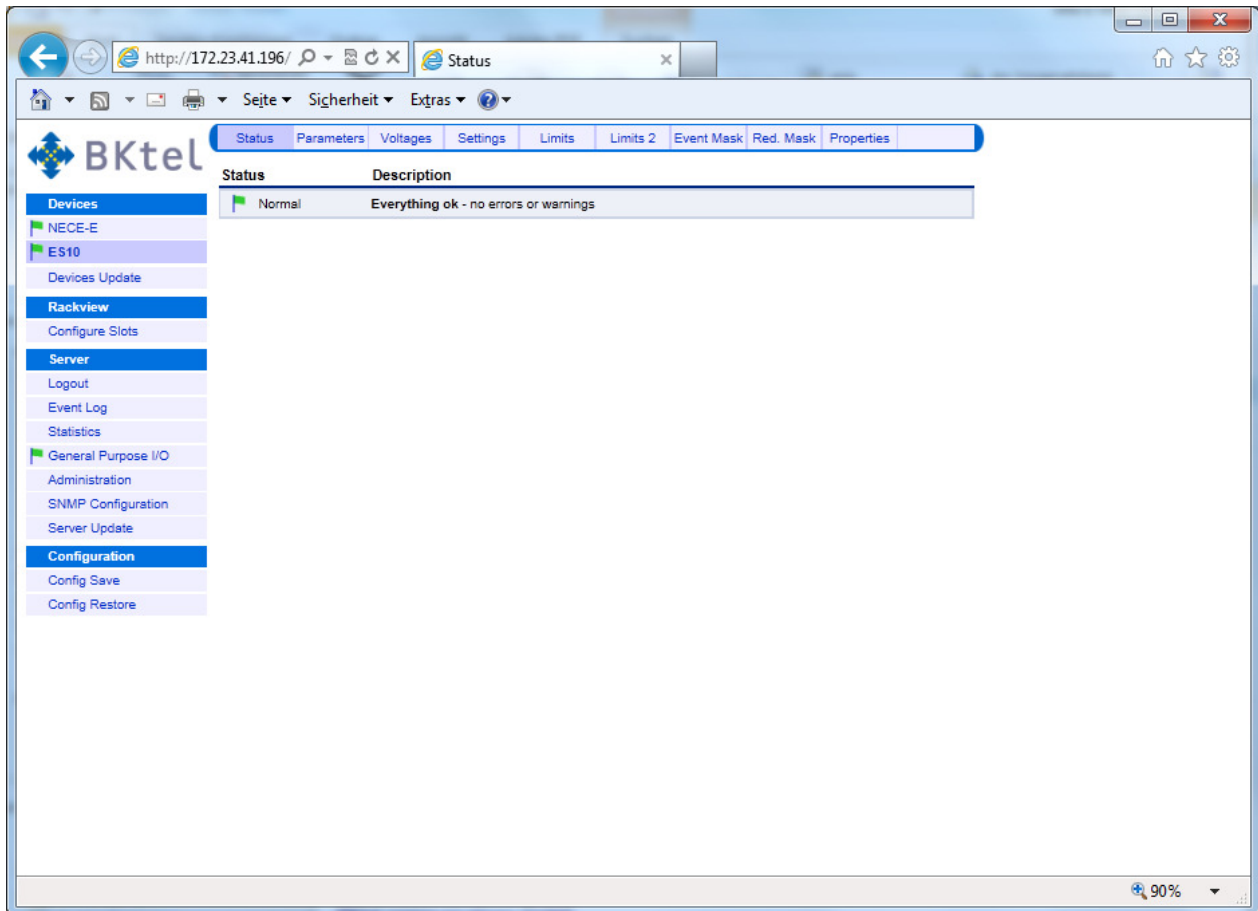


Fig. 6.1.1: Status page

The actual status of the transmitter is shown using a mark and a description.

There are several marks, filled or unfilled, used to show all events.

- A green flag indicates that the transmitter is working properly.
- An orange flag shows a warning. A certain parameter is out of the nominal range. The reason for that should be checked and solved as soon as possible.
- A red flag shows an urgent alarm. An immediate action is required to fix the failure.
- An exclamation mark provides a message about a certain mode of operation or change

6.2 Alarm and Warning Messages in the Status Page

Alarm Flags

Flag	Description
TEC_HIGH_ALARM	Peltier current is higher than the alarm limit (> 100%), (Laser switched off)
OUTPUT_PWR_LOW_ALARM	Optical output power is lower than the alarm limit
RF_INPUT_LOW_ALARM	RF signal is lower than the alarm limit
OUTPUT_PWR_HIGH_ALARM	Optical output power is higher than the alarm limit
RF_INPUT_HIGH_ALARM	RF signal is higher than the alarm limit
OMI_OR_RFGAIN_LOW_ALARM	The calculated rf gain (if AGC on) or the calculated omi (if AGC off) is lower than the alarm limit
OMI_OR_RFGAIN_HIGH_ALARM	The calculated rf gain (AGC on) or the calculated omi (AGC off) is higher than the alarm limit
RF_SIGNAL_LOSS	IF RF INPUT LOW ALARM is disabled and RF signal is lower than typical -17 dBm (guaranteed: -16 dBm)
BOOTLOADER_RUNNING_NO_APPLICATION_FIRMWARE	No application firmware loaded, f. ex. After failed firmware update
CONNECTION_LOST_NO_RESPONSE_FROM_DEVICE	Device connected to the management bus of the NEC (RS485 bus) doesn't respond
MODULE_TEMP_LOW_ALARM	Module temperature is lower than the alarm limit (< 0 °C)
MODULE_TEMP_HIGH_ALARM	Module temperature is higher than the alarm limit (> 70°C)
SBS_#1_LEVEL_ALARM	Critical failure of SBS circuitry, device has to be sent back for repair to BKtel
SBS_#2_LEVEL_ALARM	Critical failure of SBS circuitry, device has to be sent back for repair to BKtel
SBS_#1_PLL_ALARM	Critical failure of SBS circuitry, device has to be sent back for repair to BKtel
SBS_#2_PLL_ALARM	Critical failure of SBS circuitry, device has to be sent back for repair to BKtel
INTERNAL_ALARM	Internal failure generated by RF amplifier failure or modulator failure, device has to be sent back for repair to BKtel.

Table 5. Situations triggering an alarm flag in the ES10; Flags in bold letters can be controlled via the limits menu (ref. to 6.6)

Warning Flags

Flag	Description
OUTPUT_PWR_LOW_WARNING	Optical output power is lower than the warning limit
LASER_HIGH_WARNING	The laser current of one laser is higher than the warning limit (> 130%)
TEC_HIGH_WARNING	The peltier current of one laser is higher than the warning limit (< 90%)
RF_INPUT_LOW_WARNING	RF signal is lower than the warning limit
POWER_SUPPLY_WARNING	One of two power supplies fails (obsolete)
FAN_LEFT_WARNING	The left fan (looking from device's front side) fails (doesn't rotate)
FAN_RIGHT_WARNING	The right fan (looking from device's front side) fails (doesn't rotate)
OUTPUT_PWR_HIGH_WARNING	Optical output power is higher than the warning limit
RF_INPUT_HIGH_WARNING	RF signal is higher than the warning limit
POWER_SUPPLY_LEFT_WARNING	The left power supplies (looking from device's front side) fails
POWER_SUPPLY_RIGHT_WARNING	The right power supplies (looking from device's front side) fails
OMI_OR_RFGAIN_LOW_WARNING	The calculated rf gain (if AGC on) or the calculated omi (if AGC off) is lower than the warning limit
OMI_OR_RFGAIN_HIGH_WARNING	The calculated rf gain (AGC on) or the calculated omi (AGC off) is higher than the warning limit
+3.3V_LOW_WARNING	Supply +3.3V is lower than the warning limit
+3.3V_HIGH_WARNING	Supply +3.3V is higher than the warning limit
+5V_LOW_WARNING	Supply +5V is lower than the warning limit
+5V_HIGH_WARNING	Supply +5V is higher than the warning limit
-5V_LOW_WARNING	Supply -5V is lower than the warning limit
-5V_HIGH_WARNING	Supply -5V is higher than the warning limit
+12V_LOW_WARNING	Supply +12V is lower than the warning limit
+12V_HIGH_WARNING	Supply +12V is higher than the warning limit
-12V_LOW_WARNING	Supply -12V is lower than the warning limit
-12V_HIGH_WARNING	Supply -12V is higher than the warning limit
+24V_LOW_WARNING	Supply +24V is lower than the warning limit
+24V_HIGH_WARNING	Supply +24V is higher than the warning limit
LASER_TEMP_DIFF_LOW_WARNING	Laser temperature difference from nominal value is lower than the warning limit ($\geq 1^\circ\text{C}$ below nominal value)
LASER_TEMP_DIFF_HIGH_WARNING	Laser temperature difference from nominal value is higher than the warning limit ($\geq 1^\circ\text{C}$ above nominal value)
MODULE_TEMP_LOW_WARNING	Module temperature is lower than the warning limit (< 5°C)
MODULE_TEMP_HIGH_WARNING	Module temperature is higher than the warning limit (> 65°C)

Table 6. Situations triggering a warning flag in the ES10; Flags in bold letters can be controlled via the limits menu (ref. to 6.6)

6.3 Parameters

The parameters page displays the most important values of the transmitter for operation.

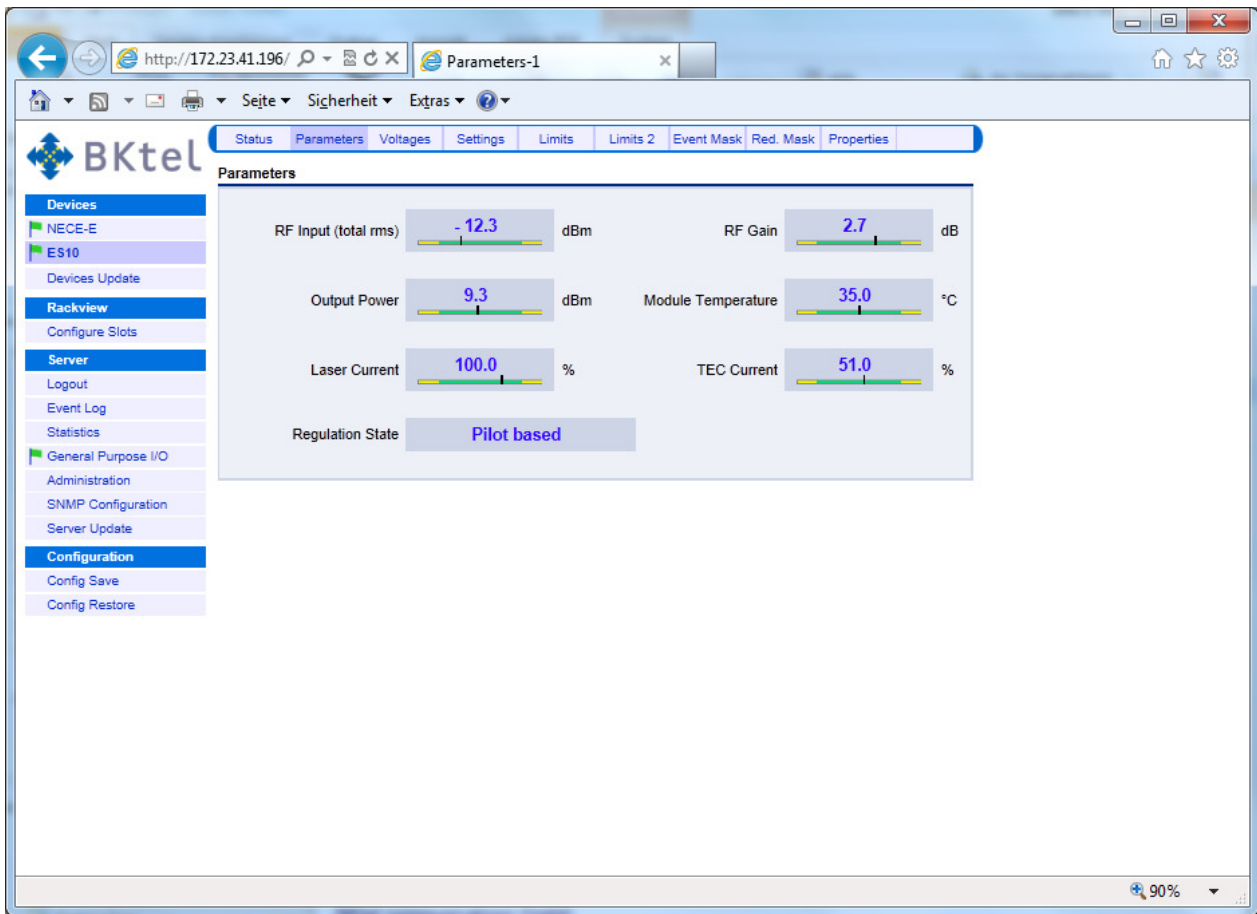


Fig. 6.3.1: Parameters page

For proper operation, the black vertical bars should meet the green fields. Note: The scaling of the green and yellow fields might be different in order to obtain a good reading, especially of the green field.

6.4 Internal Voltages

The voltages page displays all internal supply voltages like shown below.

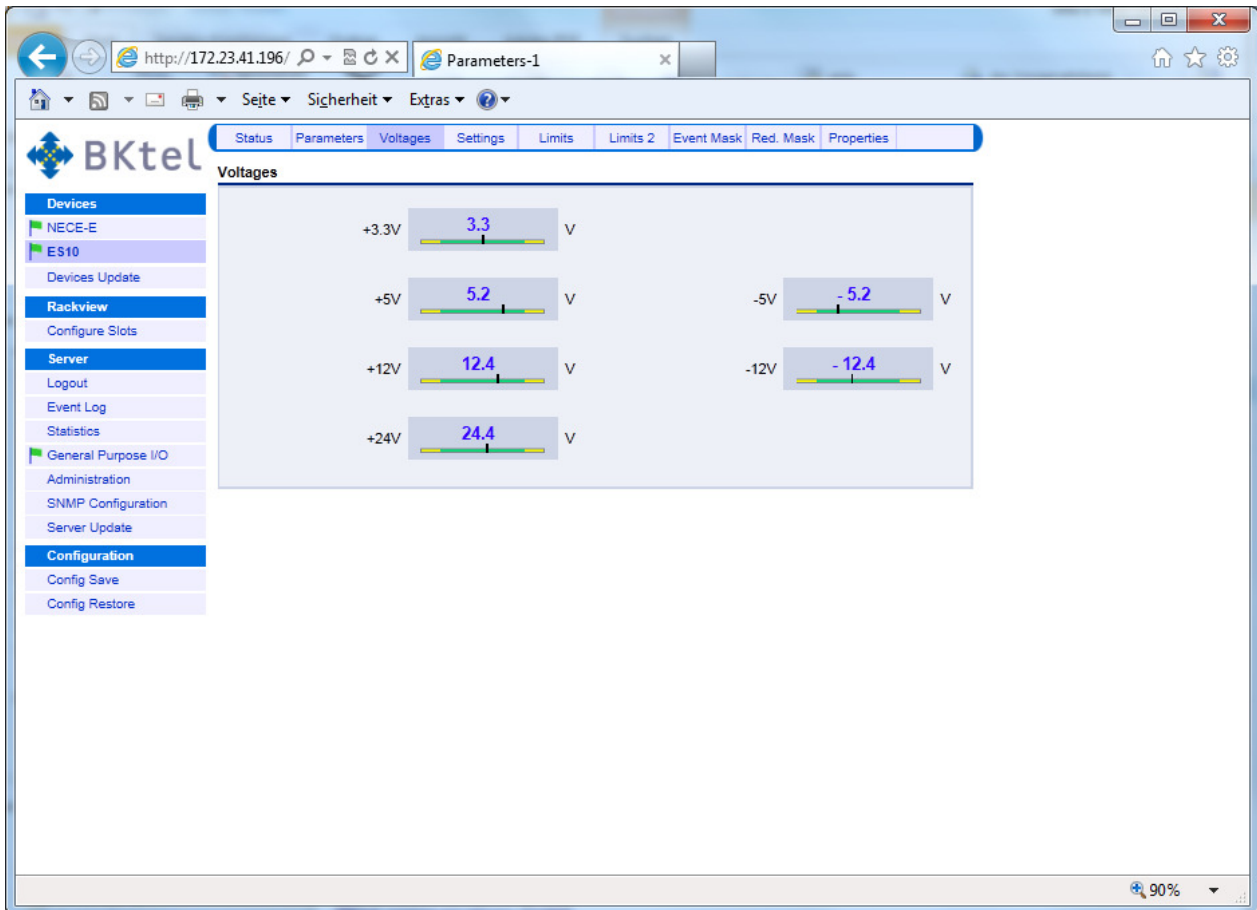


Fig. 6.4.1: Internal Voltages page

For proper operation, the black vertical bars should meet the green fields. Note the thresholds for alarms are not adjustable by the user but are factory settings only.

6.5 Settings Menu

This menu allows changing some basic adjustments of the ES10.

Note: Some of the settings require certain hardware and software releases. Please refer to the manual supplied with the transmitter if some options are different or missing compared to this figure.

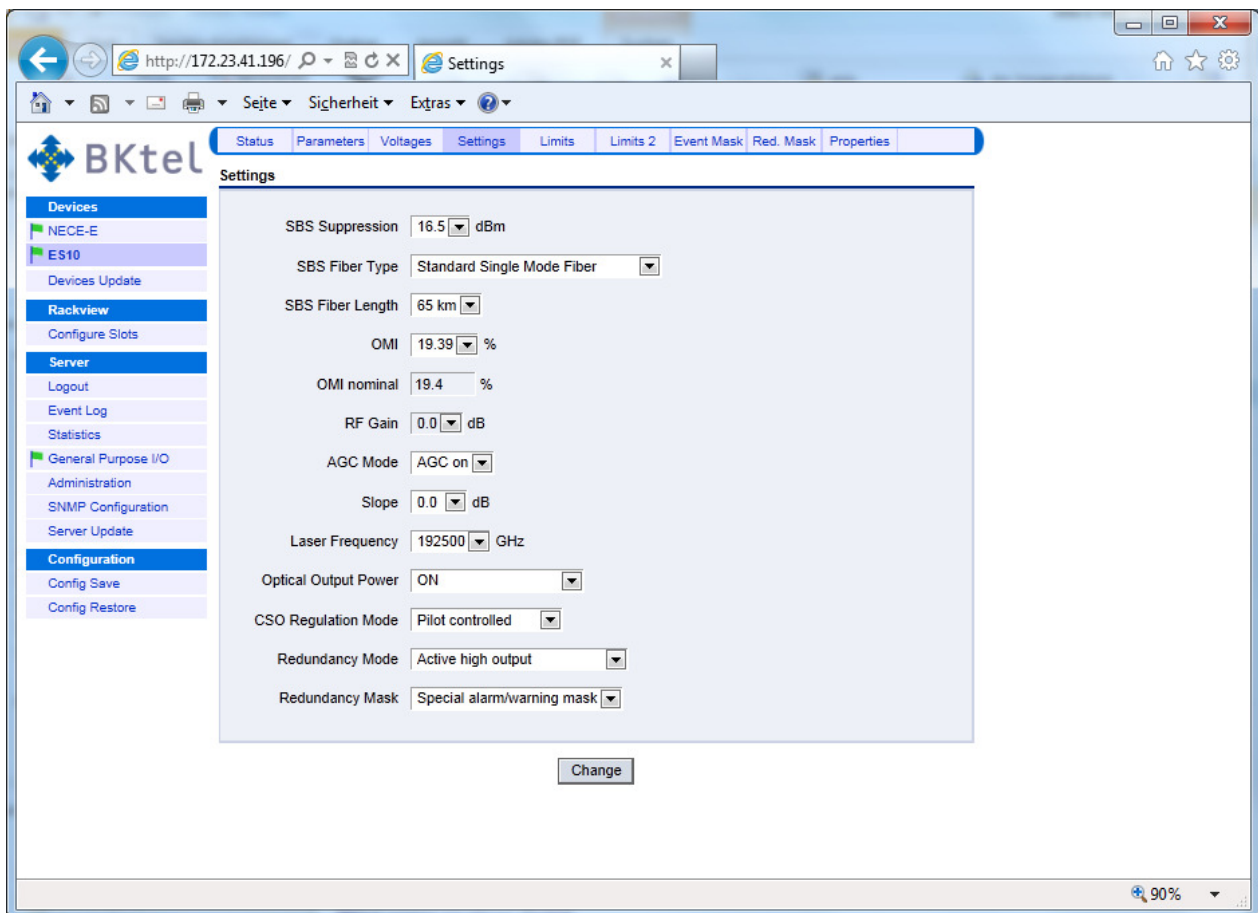


Fig. 6.5.1: Settings menu of ES10

6.5.1 Changing SBS Threshold

The figure below shows, how to change the SBS suppression (threshold) between 13.0 and 23.5 dBm. It is important to understand, that the SBS setting has a major impact on the transmission performance, especially for very long fiber transmission (e.g. 100 km) and high frequencies. The SBS suppression can be adjusted in 0.1 dB steps (calibrated). Please refer to 4.3.7.

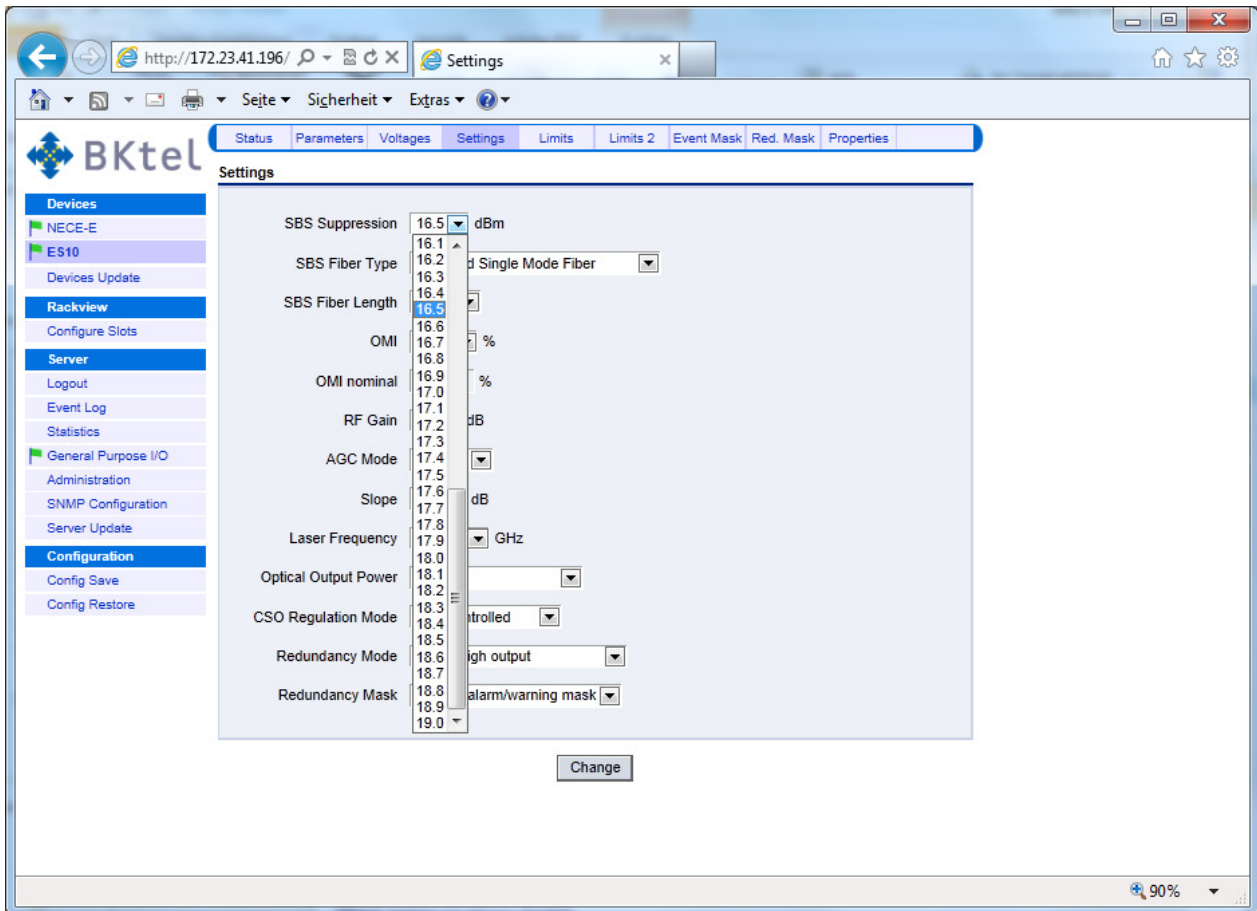


Fig. 6.5.2: Changing the SBS threshold of the ES10XL

6.5.2 Changing SBS Fiber Type and SBS Fiber Length

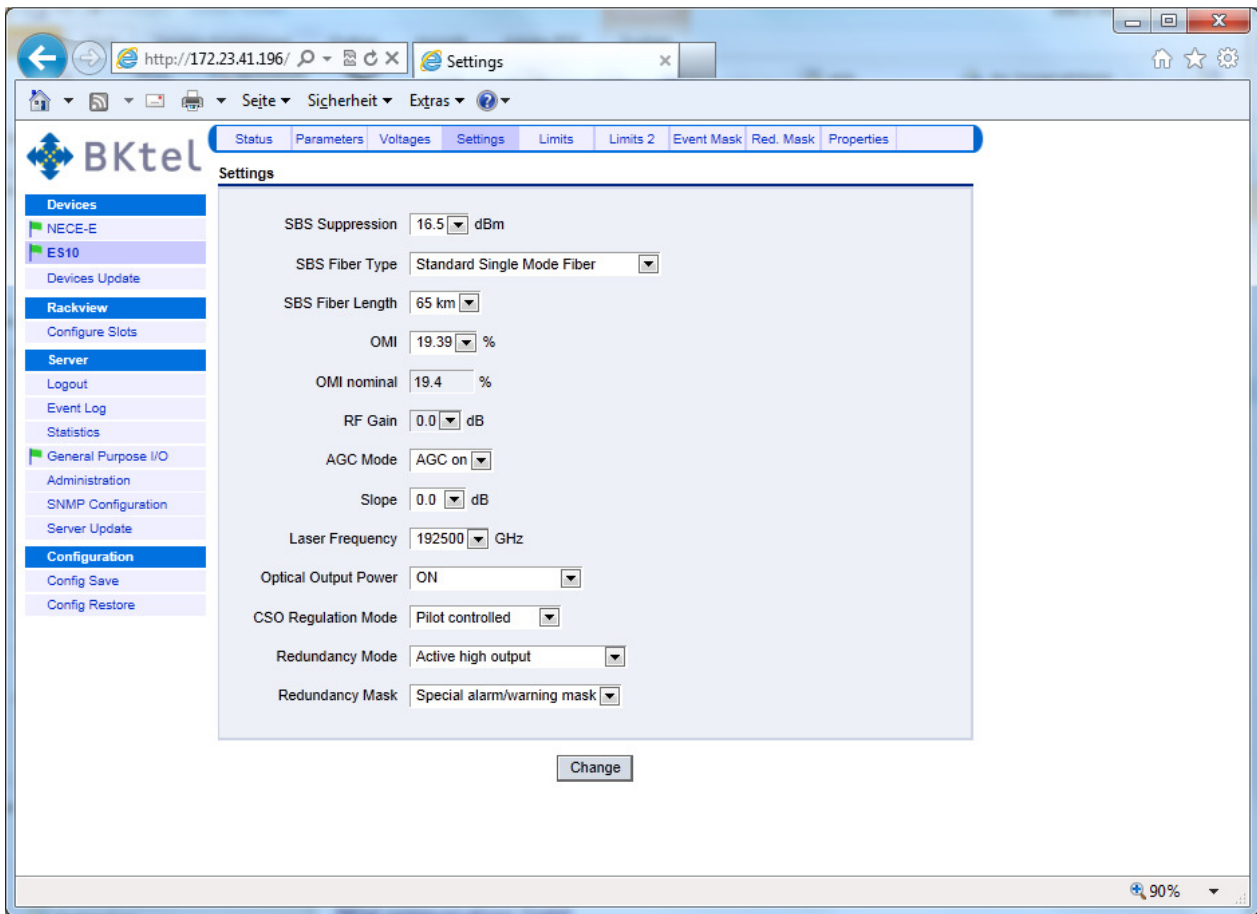


Fig. 6.5.3: Changing SBS fiber type and SBS fiber length

The SBS suppression is calibrated for different types of single mode optical fibers and fiber lengths. In the menu 'SBS Fiber Type' a selection is possible between standard fiber and SBS enhanced fiber. In the menu 'SBS Fiber Length' the length of the fiber used can be selected (more details see 4.3.7).

6.5.3 Changing $\text{OMI}_{\text{totrms}}$ (AGC on mode only)

The figure below shows, how to adjust the RF OMI total rms, in order to optimize the transmission performance in terms of CNR, CSO, CTB and BER. The RF $\text{OMI}_{\text{totrms}}$ is shown in %, enabling an easy comparison e.g. with the graphs as shown in 4.3.

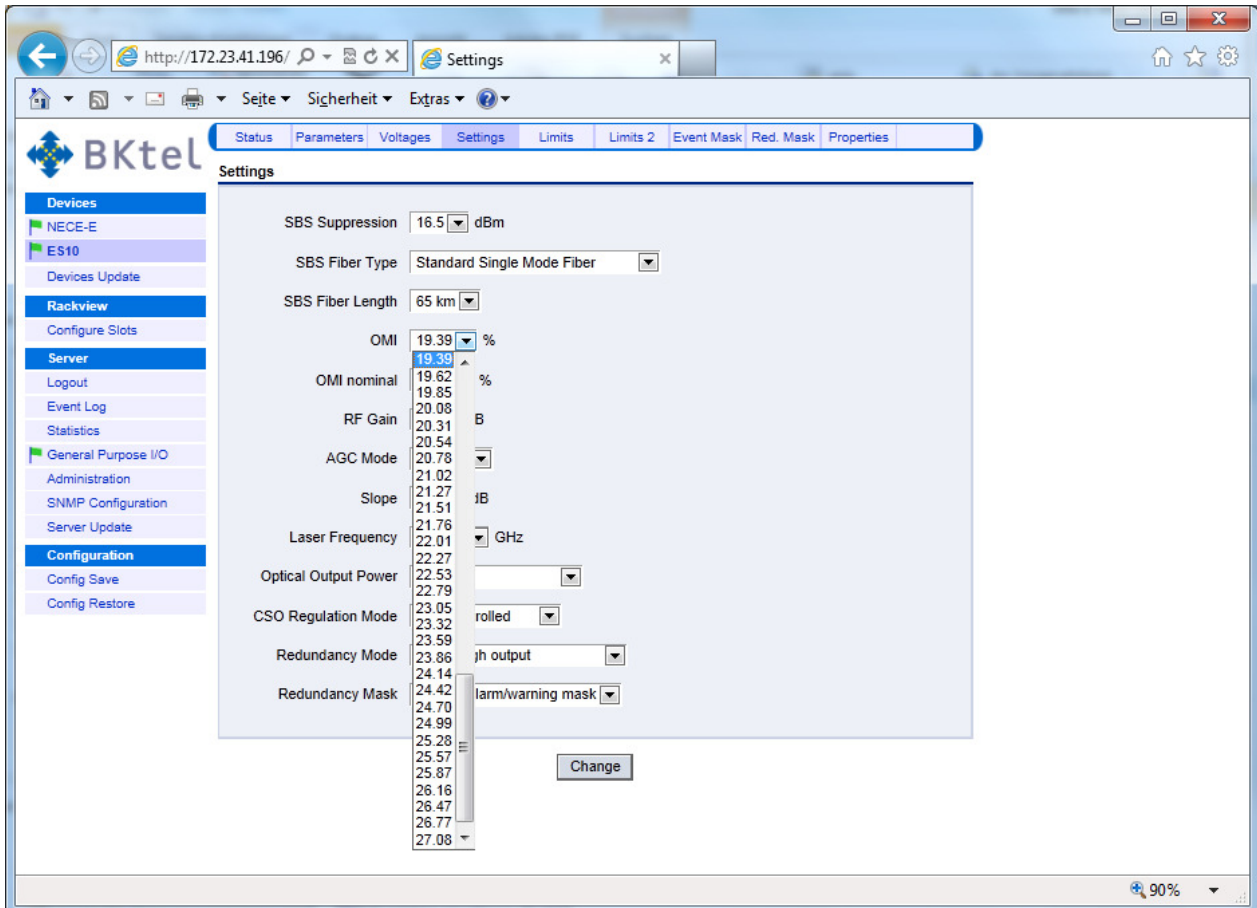


Fig. 6.5.4: Setting RF $\text{OMI}_{\text{totrms}}$ of ES10

Notes:

1. OMI nominal refers to a factory setting and cannot be changed by the user.
2. RF- $\text{OMI}_{\text{totrms}}$ setting is only relevant in AGC-on mode.
3. The setting range for RF- $\text{OMI}_{\text{totrms}}$ might change slightly from device to device due to production tolerances.

6.5.4 Setting Gain (AGC off mode only)

The figure below shows how to adjust the RF gain, in order to optimize the transmission performance in terms of CNR, CSO, CTB and BER.

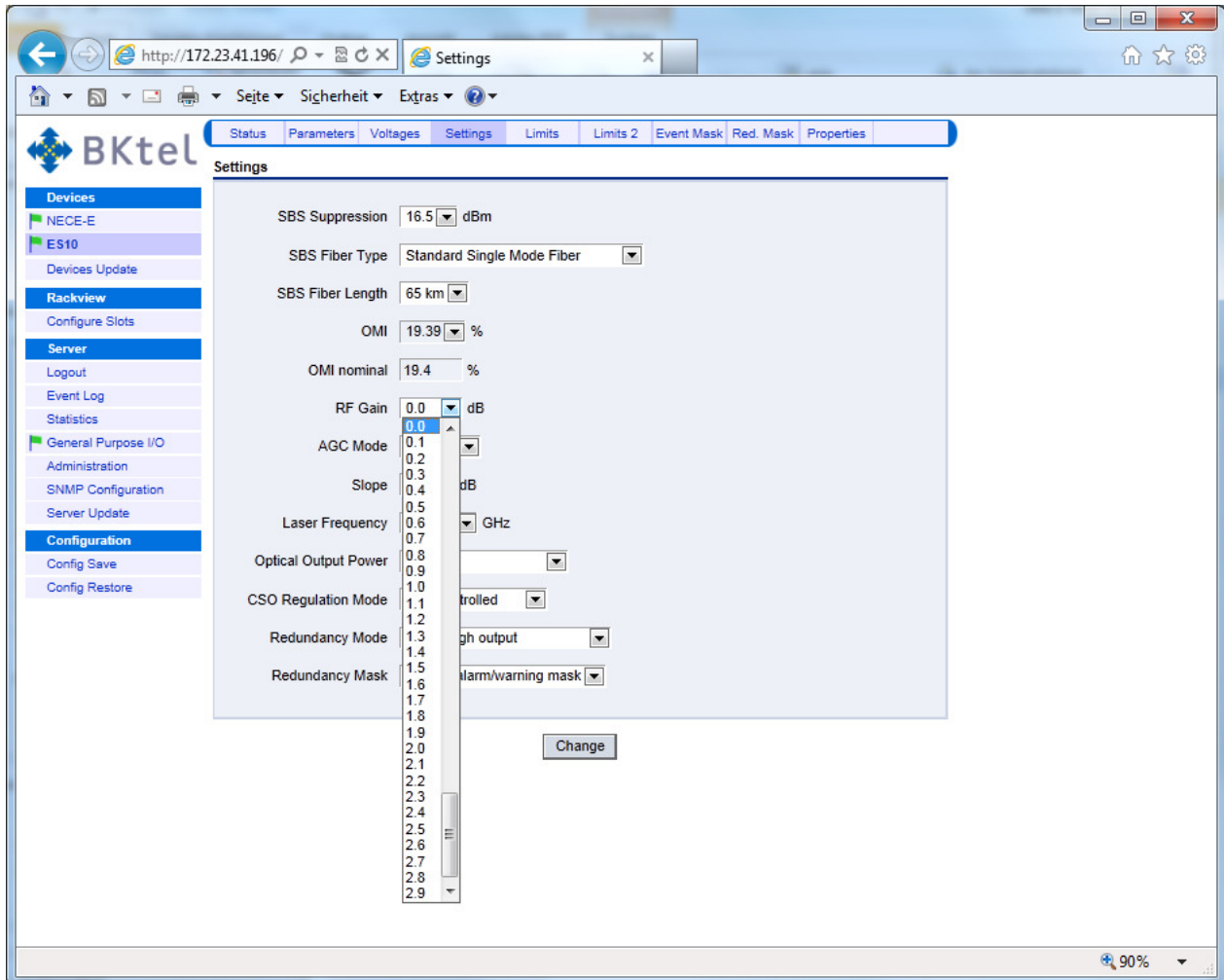


Fig. 6.5.5: Setting RF gain of ES10

Notes:

1. The RF gain setting is only relevant in AGC-off mode.
2. The setting range for RF gain might change slightly from device to device due to production tolerances.
3. Changing the RF gain changes the input sensitivity of the ES10 in AGC off mode; 0 dB is the nominal RF gain. Setting the RF gain to e.g. 2 dB improves the input sensitivity of the ES10 from e.g. 80 dBμV to 78 dBμV.

6.5.5 Changing AGC Mode

The transmitter can be operated in manual- (AGC off) as well as an automatic- gain controlled (AGC on) mode. For details please refer to 4.3.2.

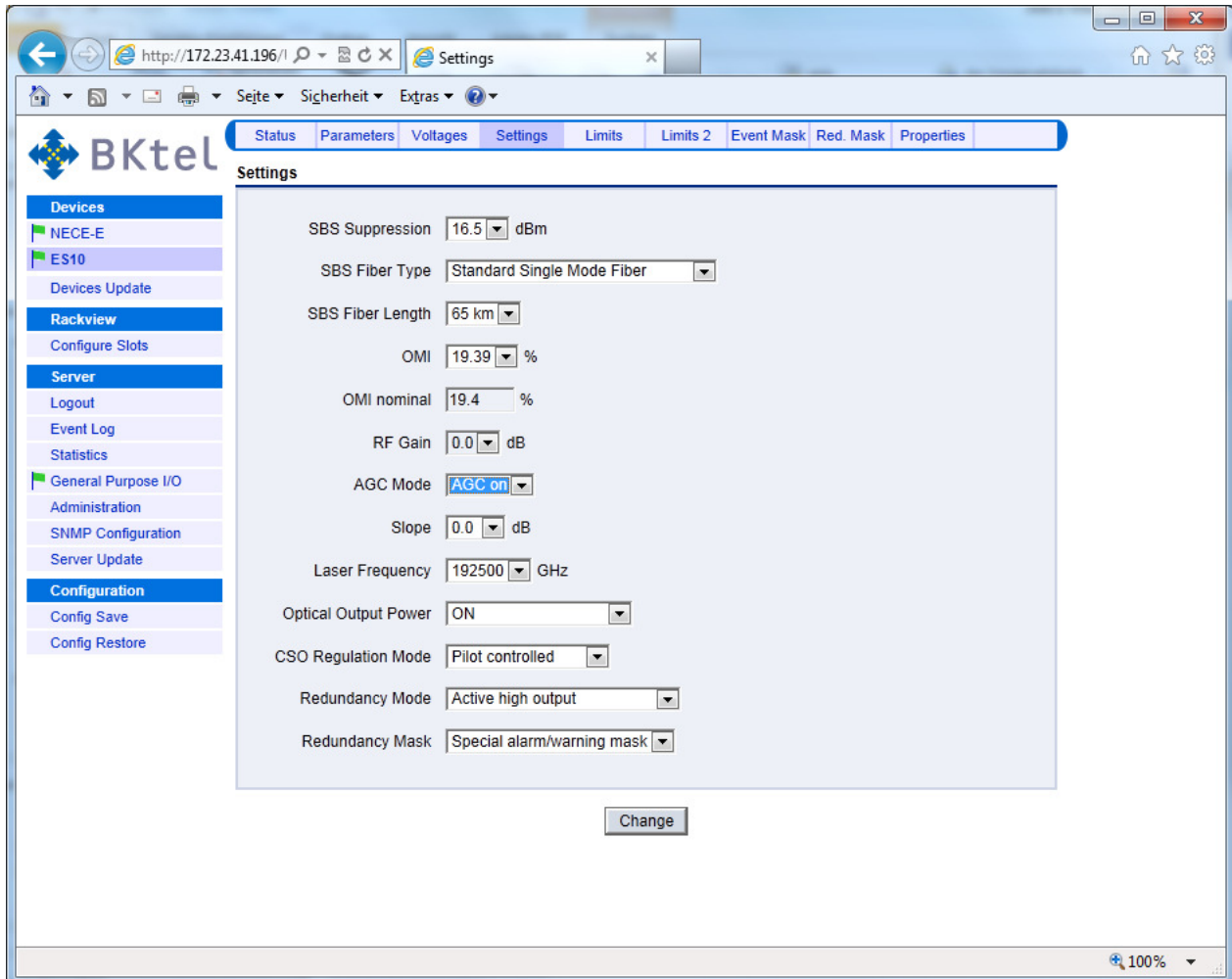


Fig. 6.5.6: Selecting the RF AGC mode of the transmitter of ES10

6.5.6 Setting Slope

The ES10 enables to change the slope of its internal RF amplifier stages. The slope equalizer follows a RF cable compensating or RF cable simulating characteristics.

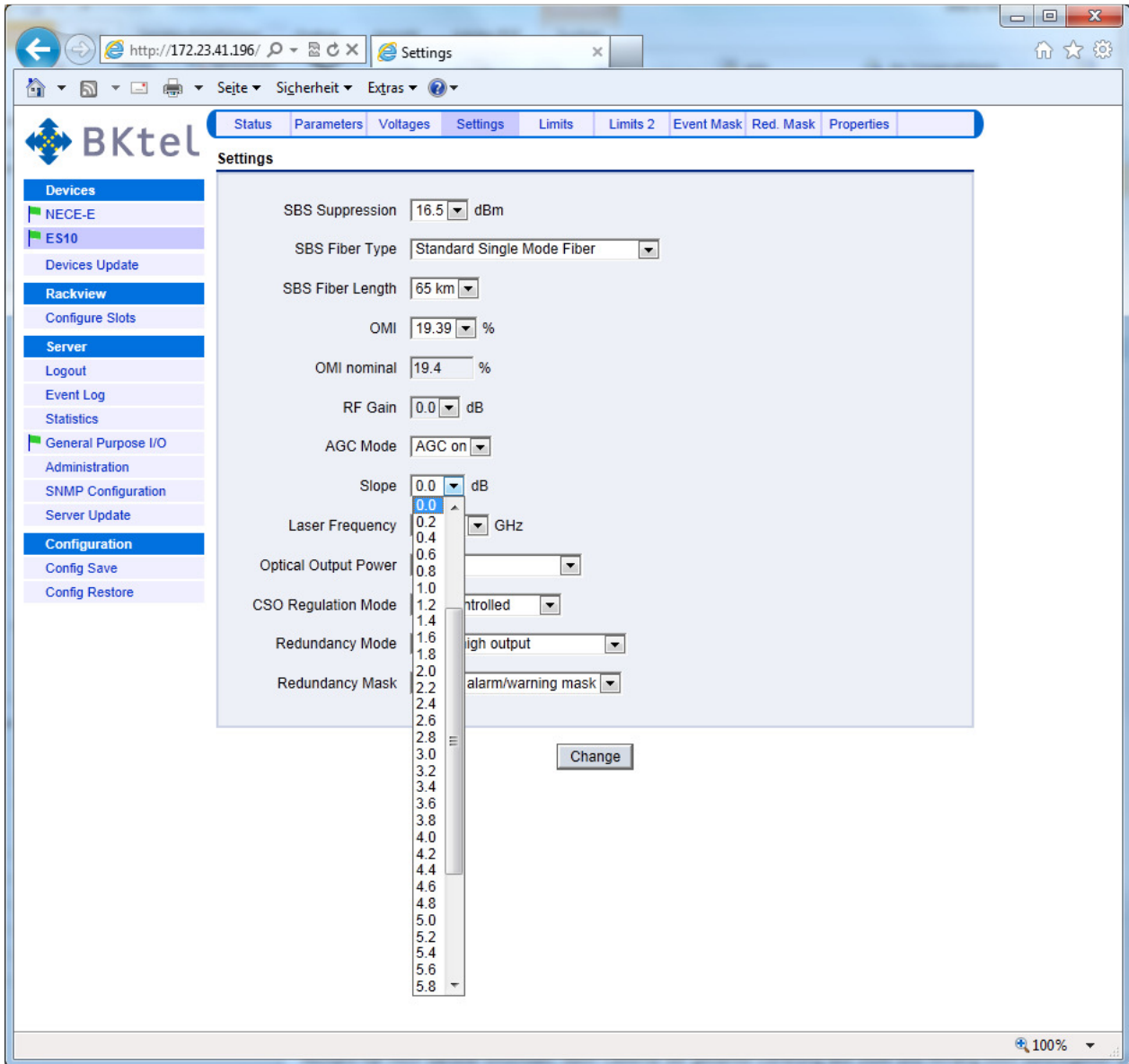


Fig. 6.5.7: Setting the RF gain slope

6.5.7 Changing ITU Laser Frequency

The figure below shows, how to change the ITU frequency (optical wavelength) of the transmitter in steps of 50 GHz up to +/- 100 GHz (not available for ES10L).

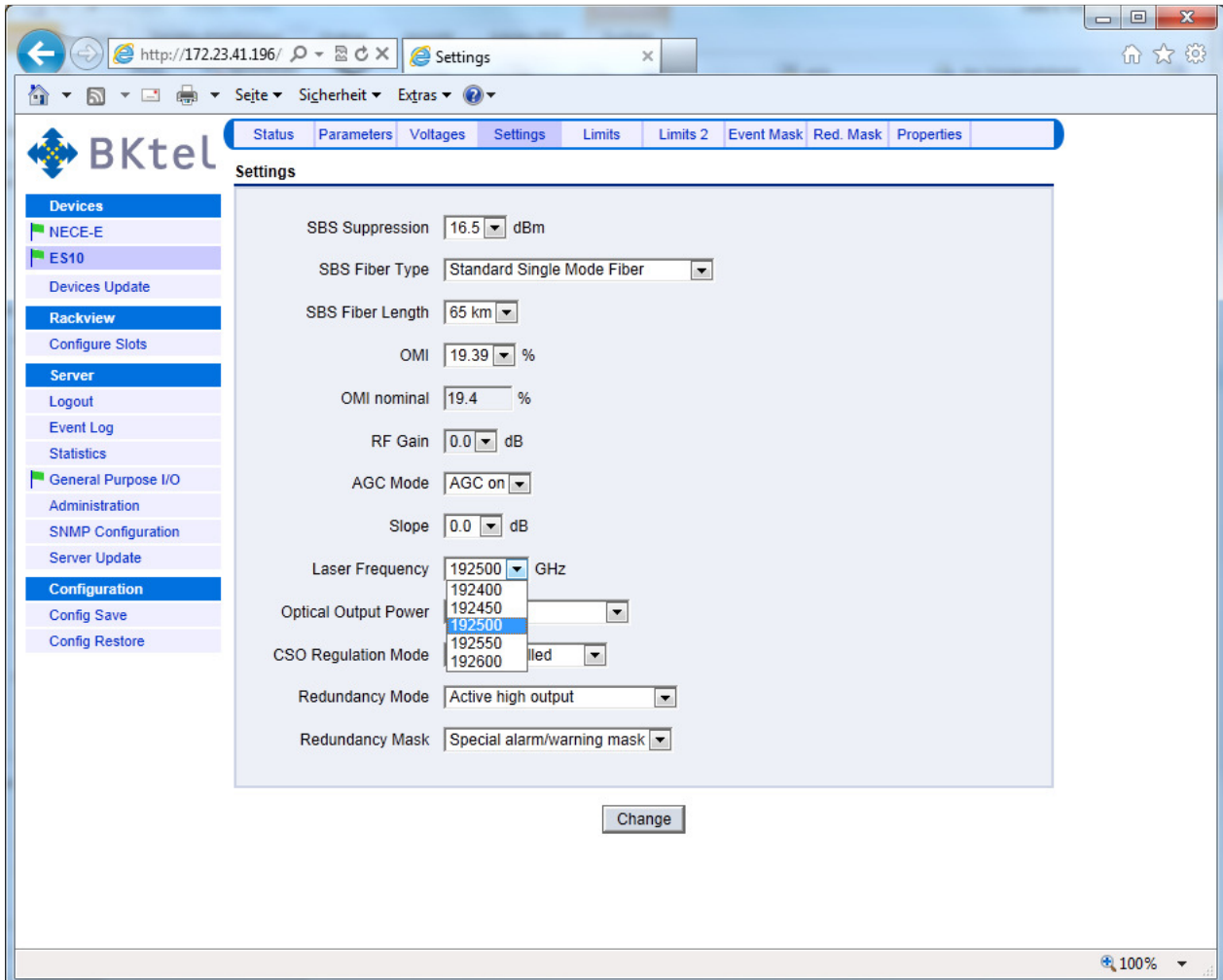


Fig. 6.5.8: Changing the ITU frequency of the transmitter ES10XL

6.5.8 Changing Optical Output Power Mode

There are 3 different output power modes available for the ES10 as shown in the figure below:

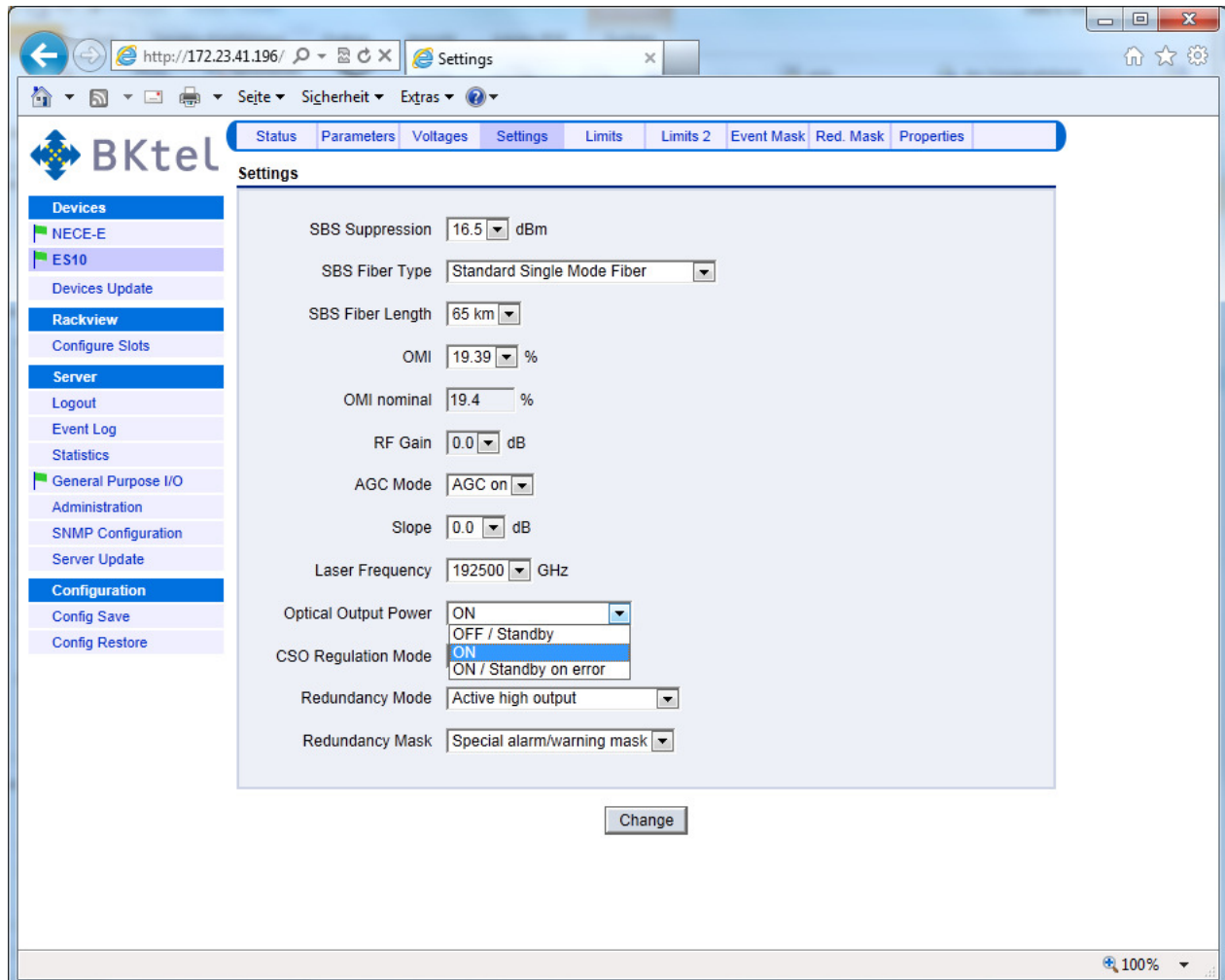


Fig. 6.5.9: Setting the optical output power mode of ES10

1. OFF / Standby. By selecting this mode the ES10 will operate with optical output power switched off. However, the laser temperature is still kept at the operating temperature by driving the peltier cooler enabling a fast switching-on time. Additionally the RF input monitor is operating. Note: In future software releases it is intended not to completely switch off the optical power but to decrease the optical power below a certain threshold (e.g. -3 dBm) in order to enable the supervision of the laser in standby mode and in order to enable the supervision of the fiber link between the ES10 and the subsequent EDFA or RX.
2. ON. The transmitter output power is always on (**default = factory setting**).
3. ON / Standby on alarm. The transmitter output power is on, as long as there is no internal alarm. In case that an alarm condition occurs, the output power is switched into standby mode. This operating mode has been designed especially for redundant transmitter operation: If e.g. an RF input alarm occurs, the optical output power is switched to standby mode. This consequently should also disable the subsequent EDFA. If a pair of two ES10 with subsequent EDFA are intended to be used for redundant operation (master/slave

mode, ref. to 6.5.10) this feature will automatically switch from the master TX + EDFA to the slave TX + EDFA. In this case the I/O No. 0 ports of both ES10 have to be connected and the master/slave settings according to 6.5.10 have to be chosen. Note: The requirements for an alarm condition can be set by adjusting the alarms thresholds as explained in 6.5.11.

6.5.9 Changing Regulation Mode

The figure below shows, how to change the CSO regulation mode of the transmitter. For details please refer to 4.3.2.

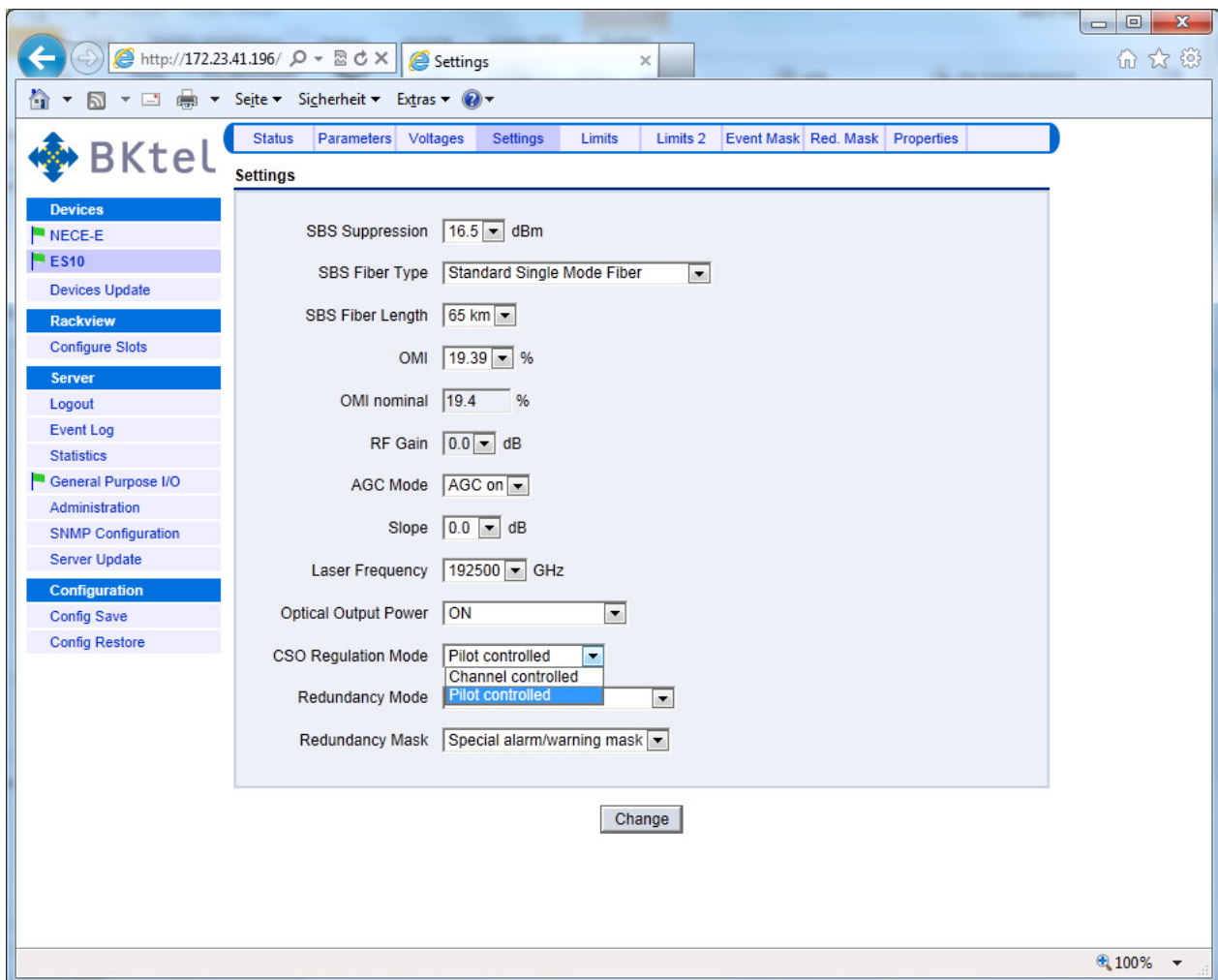


Fig. 6.5.10: Changing the CSO Regulation Mode

6.5.10 Changing Redundancy Mode

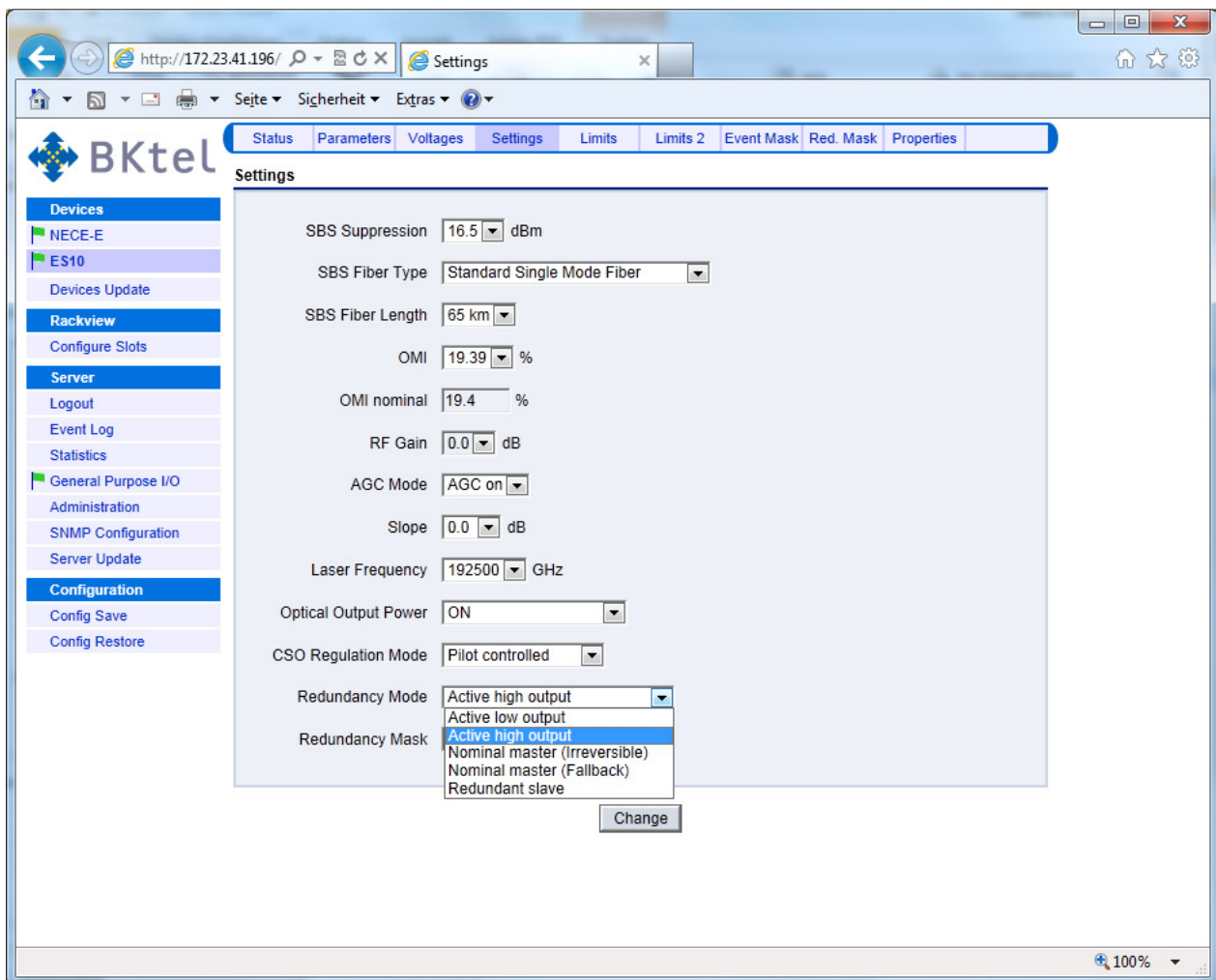


Fig. 6.5.11: Setting the redundancy port mode

The redundancy mode menu is used to configure redundancy setup between two ES10 (device redundancy). The I/O port #0 is dedicated for this purpose and the menu Redundancy mode directly manipulates this port. The I/O port can be set either to be an output port with 4 modes of operation available:

- active low
- active high (**default = factory setting**)
- nominal master (irreversible) or
- nominal master (fallback)

or to be an input port, which implies the redundant slave mode.

The table below shows the mode of operation and the impact on I/O port No. 0

Mode of operation	Description	I/O port #0
Active low	In case of alarm or warning, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes low.	Output, active low
Active high (Default = factory setting)	In case of alarm or warning, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes high.	Output, active high
Nominal master (irreversible)	In case of alarm or warning, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes high. In case the alarm condition disappears, the transmitter will remain in the alarm state until it is reset manually. This mode is implemented to prevent a frequent switching into active/stand-by mode of two redundant transmitters.	Output, active high This port should be connected to the corresponding I/O port #0 of the redundant transmitter which is set into redundant slave mode.
Nominal master (fallback)	In case of alarm or warning, which arises in case any of the alarm thresholds has been reached or due to an internal error the I/O port becomes high. In case the alarm condition disappears, the transmitter will go back into normal operation, which will set the connected redundant slave mode into stand-by operation.	Output, active high This port should be connected to the corresponding I/O port #0 of the redundant transmitter which is set into redundant slave mode.
Redundant slave	In case that the input port is low, the transmitter will go into stand-by operation. In case that the I/O port #0 (input) will become high, the transmitter will go into normal (nominal) mode.	Input, active high This port should be connected to the corresponding I/O port #0 of the redundant transmitter which is set into redundant master mode.

Note:

Note: The redundancy mask determines which alarms or warnings trigger the I/O port #0 in output mode. This is described in the chapter 6.5.11.

Application: Automatic redundancy switching of two ES10 located side by side:

- Connect a cable between the master and the slave ES10 connecting both I/O #0 ports and GND.
- Set the master ES10 in one of the two Nominal master modes
- Set the master ES10 I/O port mask to the desired mode. Set the slave ES10 into the Redundant Slave mode

Observance:

- As long as the master ES10 does not show any alarm, the slave ES10 should be sleeping (in stand-by operation), since the I/O port #0 level will be in low state.
- If the master alarm faces an alarm situation, it will set the I/O port #0 level to high state, therefore awakening the slave transmitter from sleeping (stand-by mode).
- If the cable between the master ES10 and the slave is cut or removed, the slave device will go from sleeping (stand-by) mode into normal operation due to the internal 100 kΩ pull-up resistor.
- If the power supply from the master ES10 is removed completely, the slave device will go from sleeping (stand-by) mode into normal operation immediately.

Note:

The slave transmitter might need up to 5 seconds to provide a high performance output signal, when starting from stand-by. For that reason, the master transmitter will after an alarm situation create an I/O port high signal to start the slave transmitter and will, however, operate in normal mode (as far as possible) for five seconds, until it switches into stand-by mode. The purpose of this method is to make the interruption of the signal as short as possible.

An overview of all alarm and warning flags, which can create an alarm or warning situation, is given in chapter 6.2.

6.5.11 Setting Redundancy Mask

The redundancy mask determines whether only alarms but no warnings (**default = factory setting**) or alarms and warnings trigger the I/O port #0 in output mode. The menu is shown in the figure below.

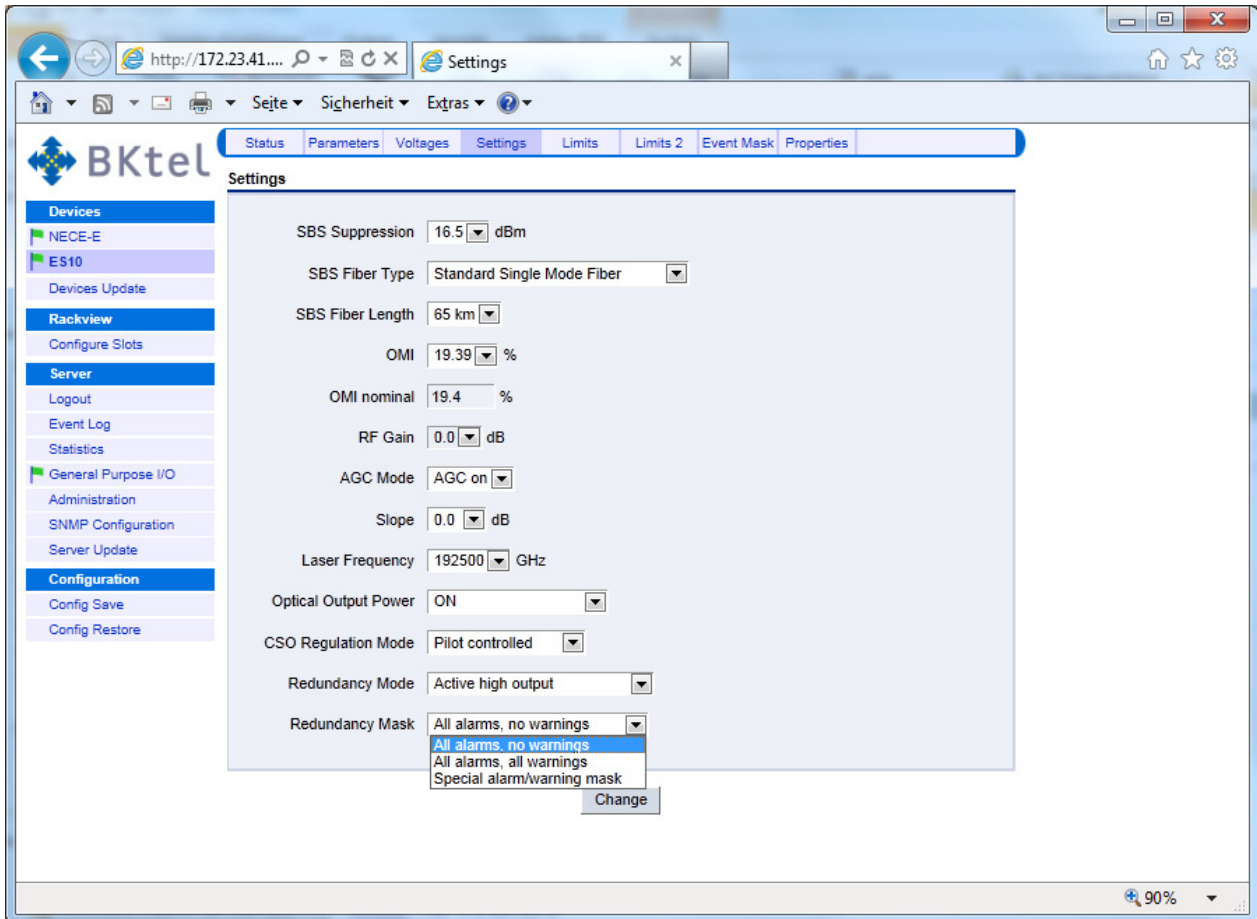


Fig. 6.5.12: Setting the alarm/warning mask for the output port

With this feature all warnings / alarms of the ES10 can be either enabled or disabled by the user in relation to the output #0 port. If the output mask is applied a notify message will be shown on the status page.

When Special alarm/warning mask is chosen an additional webpage appears which allows a specific choice of alarms and warnings triggering the redundancy switching. It is described in the next chapter.

6.5.12 Selecting a Redundancy Mask

When Special alarm/warning mask is chosen an additional webpage appears which allows a specific choice of alarms and warnings triggering the redundancy switching.

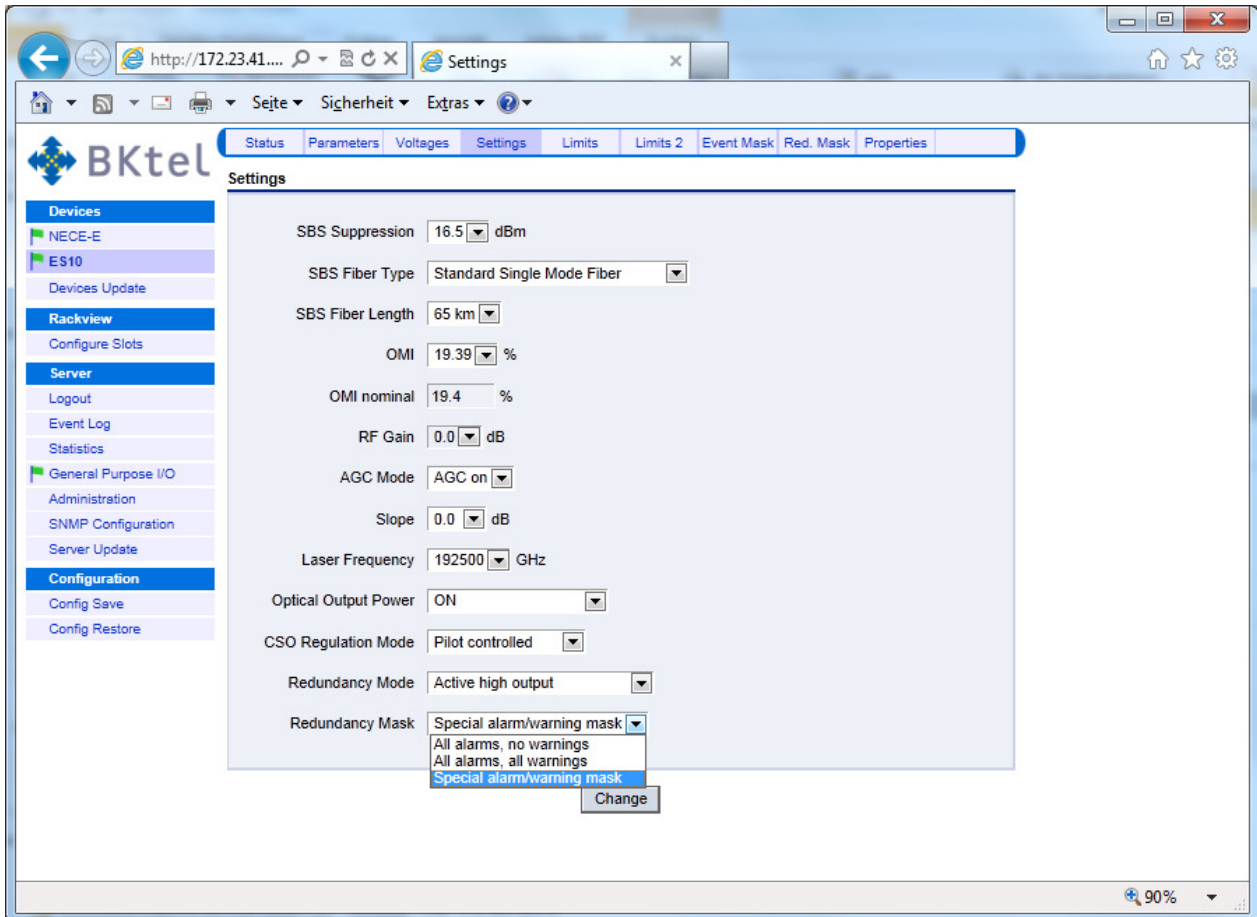


Fig. 6.5.13: Selecting a special alarm/warning mask

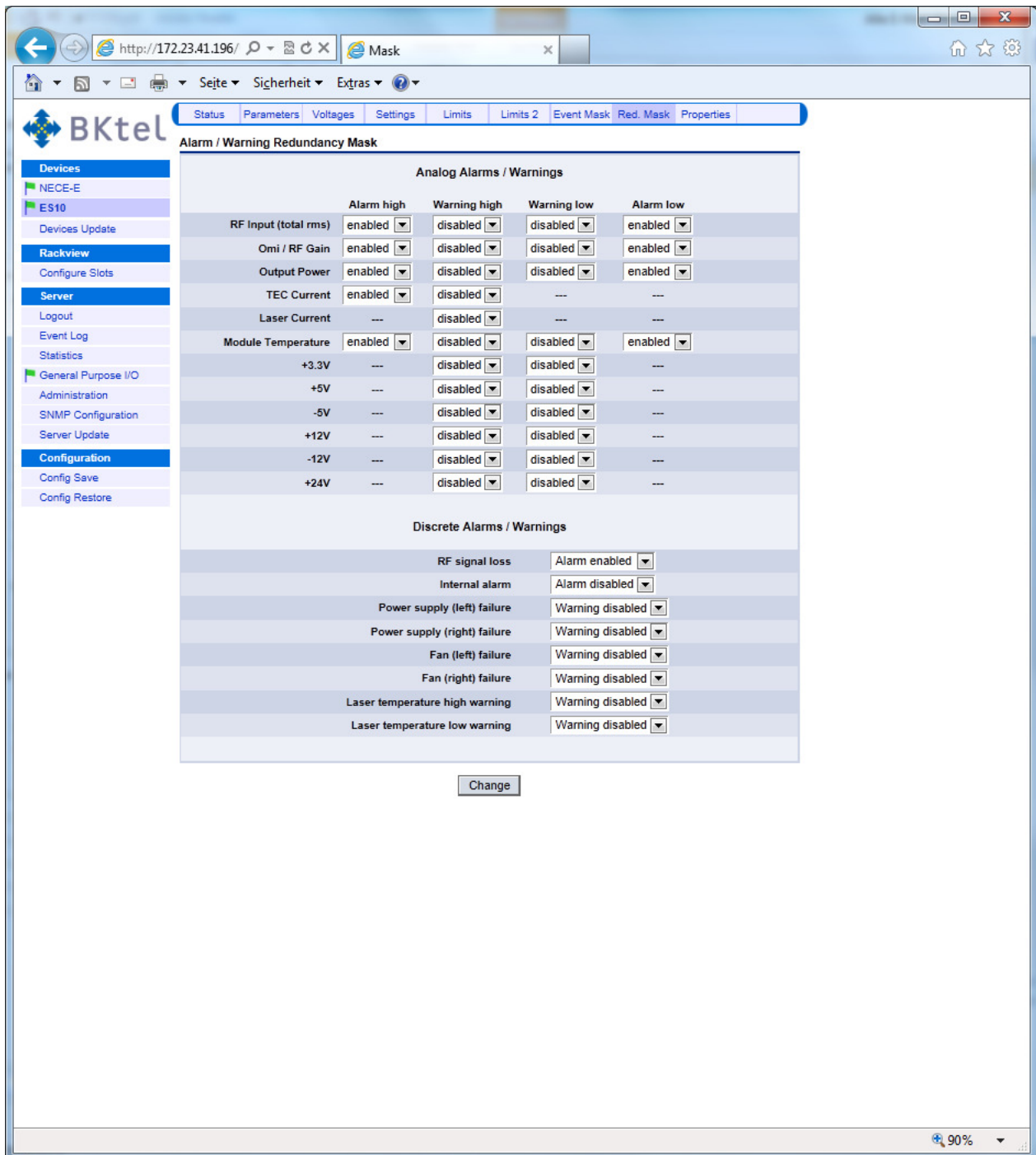


Fig. 6.5.14: Redundancy Mask menu

6.5.13 Setting CATV Signal Channel Spacing

The Channel controlled AGC mode provides a unique technology to minimize CSO distortions without requesting pilot tones. By setting the channel spacing to the correct value (ref. to 4.3.4) the CSO control loop will operate with utmost performance. The figure below shows how to set the channel spacing.

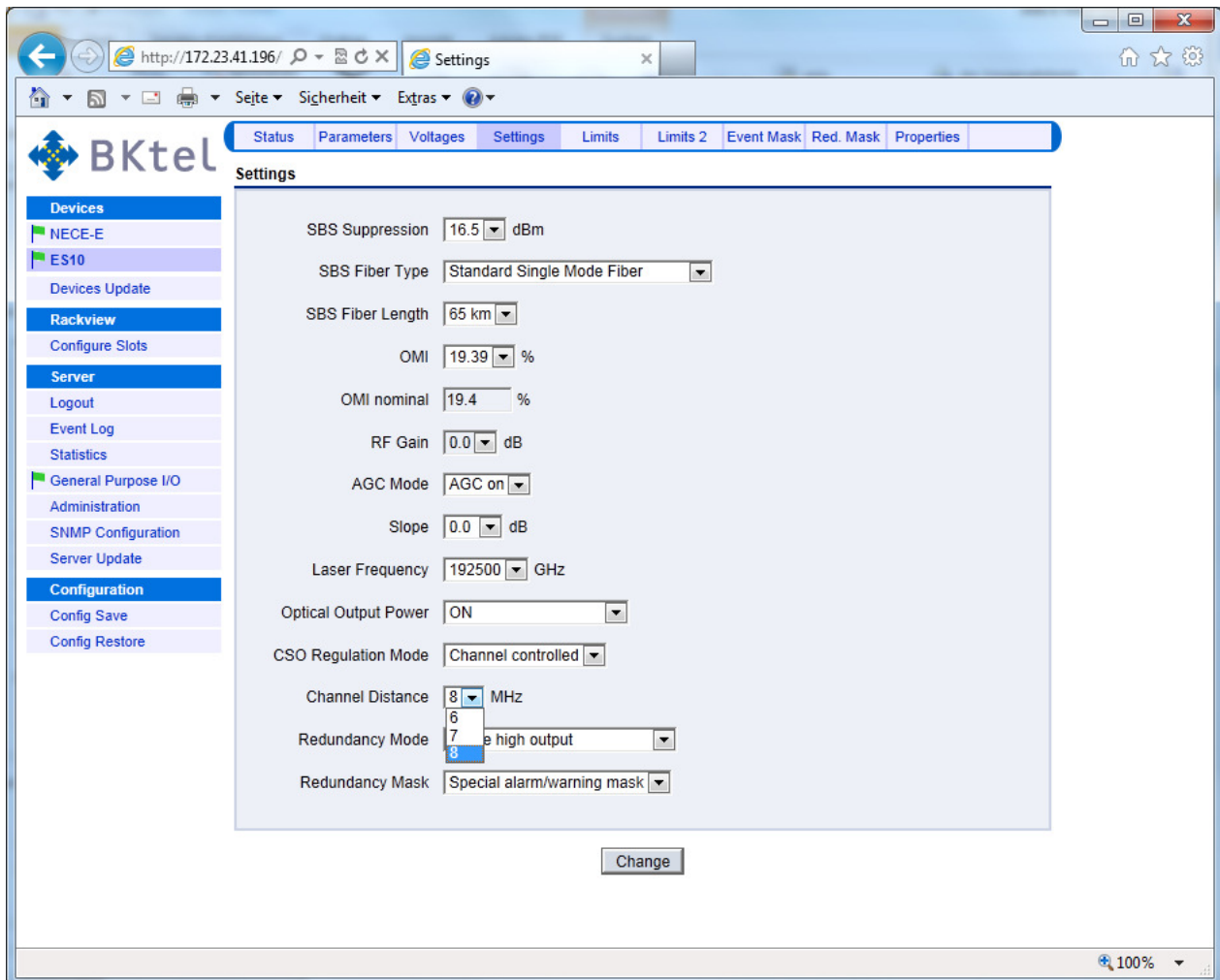


Fig. 6.5.15: Setting the channel spacing of ES10

NTSC channel plans in general provide a 6 MHz spacing; PAL-D and CENELEC channel plans in general have an 8 MHz spacing. In Europe also 7 MHz spacing is used in some channel plans.

6.6 Limits Menus

The two limits menus of the ES10 determine, what deviations from the nominal values of some of the operating conditions of the transmitter lead to either warning or alarm messages. In order to avoid inadequate changes, some settings are factory settings only.

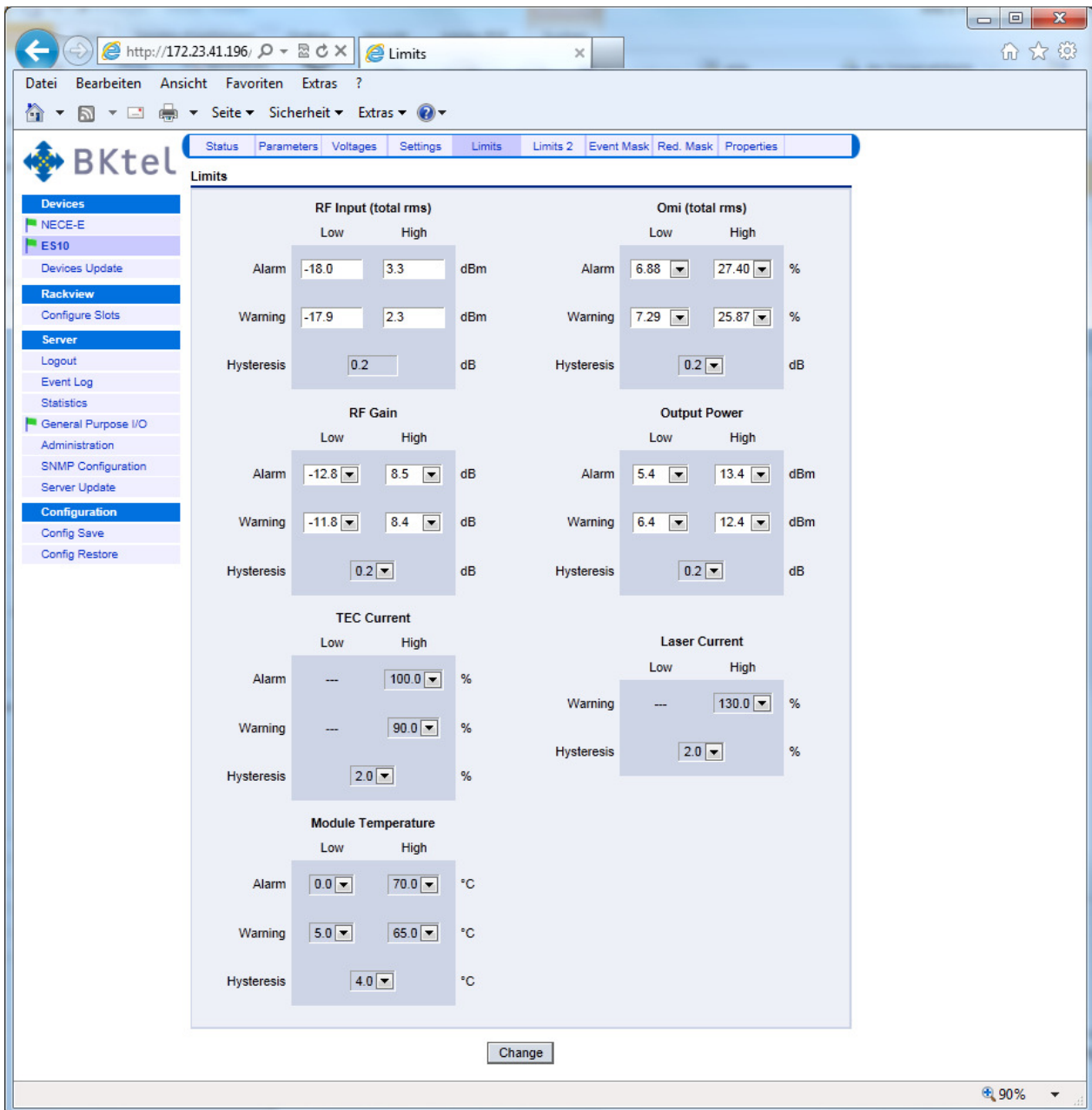


Fig. 6.6.1: Limits menu of ES10

After successful log-in, the warning and alarm thresholds for the RF_{rms} input level, OMI_{totrms} , RF gain and optical output power can be set by the customer.

It is recommended to be very careful in setting the alarm thresholds in order to avoid meaningless alarms, e.g. due to temperature changes. For the output power warning a range of at least ± 1 dB is recommended.

Note:

The settings range for the alarm thresholds for RF input, RF gain and OMI_{totrms} might change slightly from device to device due to production tolerances.

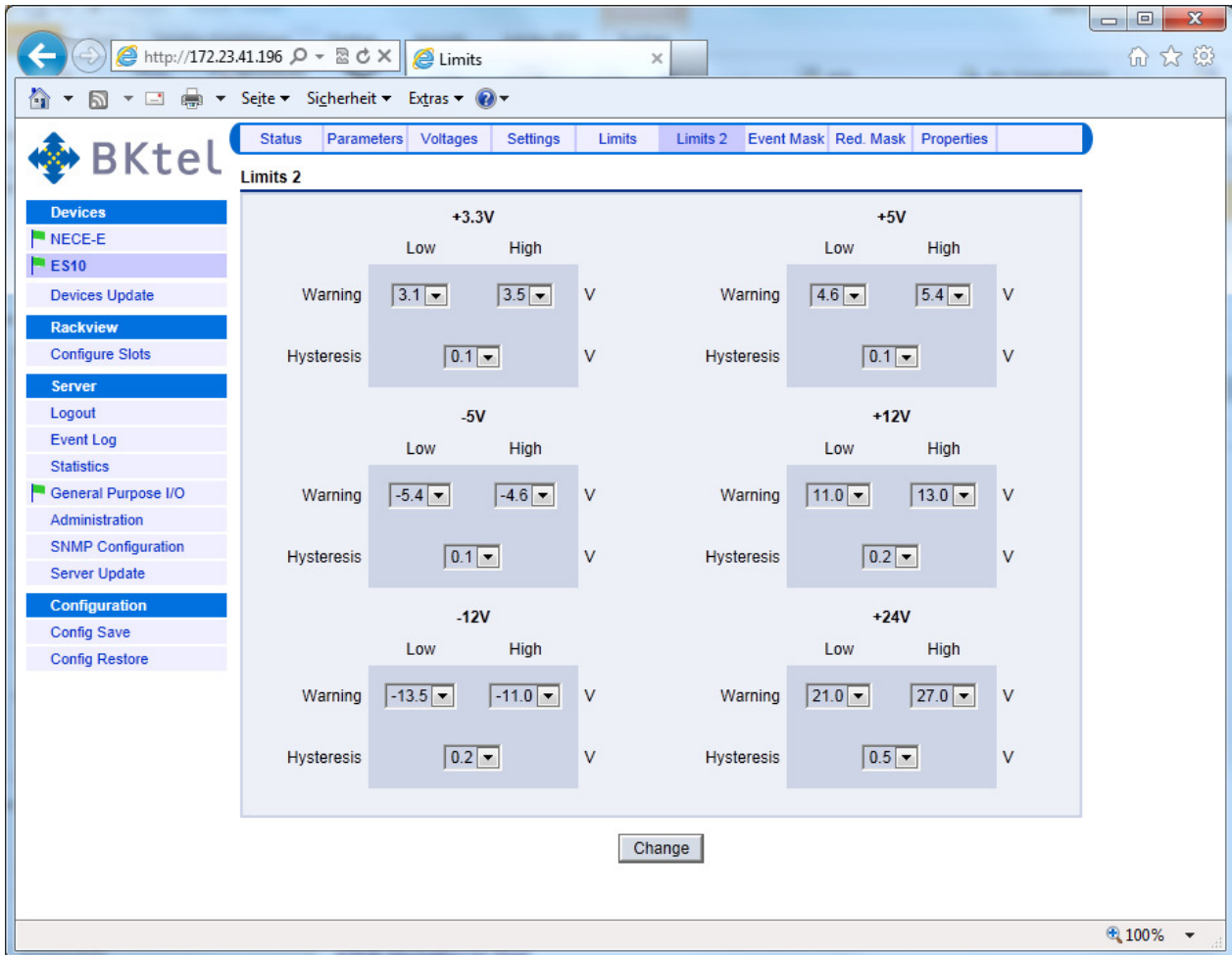
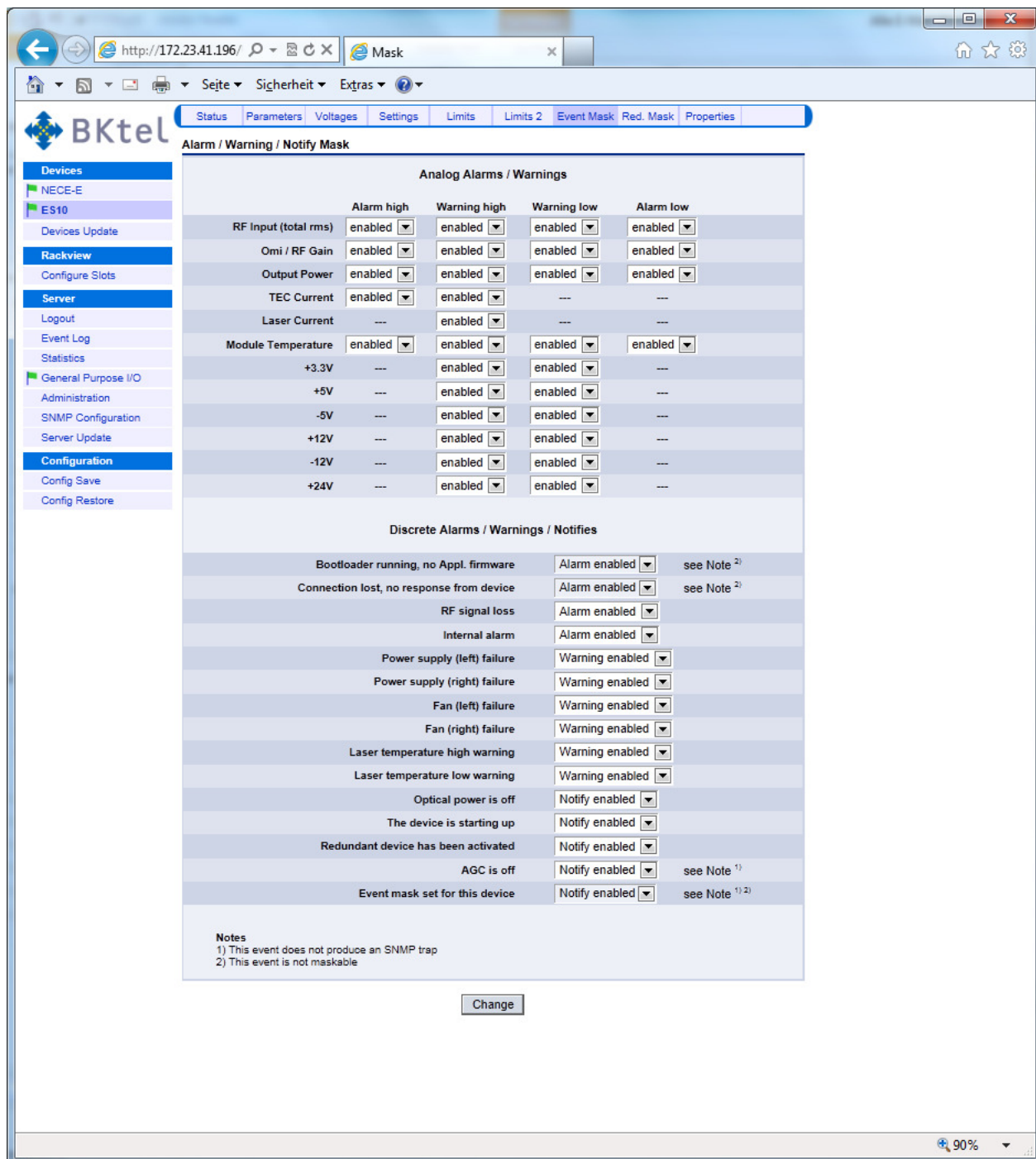


Fig. 6.6.2: Limits-2 menu of ES10

Note: All settings of the limits-2 menu are factory settings only.

6.7 Setting an Event Mask for Webserver and SNMP Interface

The ES10 allows setting an event mask, which determines whether a warning or alarm or a notification is shown or suppressed in the Webserver status screen as well as transmitted via the SNMP interface. The menu is shown in the following figure.



http://172.23.41.196/ Mask

Seite Sicherheit Extras

BKtel

Status Parameters Voltages Settings Limits Limits 2 Event Mask Red. Mask Properties

Alarm / Warning / Notify Mask

Analog Alarms / Warnings

	Alarm high	Warning high	Warning low	Alarm low
RF Input (total rms)	enabled	enabled	enabled	enabled
Omi / RF Gain	enabled	enabled	enabled	enabled
Output Power	enabled	enabled	enabled	enabled
TEC Current	enabled	enabled	---	---
Laser Current	---	enabled	---	---
Module Temperature	enabled	enabled	enabled	enabled
+3.3V	---	enabled	enabled	---
+5V	---	enabled	enabled	---
-5V	---	enabled	enabled	---
+12V	---	enabled	enabled	---
-12V	---	enabled	enabled	---
+24V	---	enabled	enabled	---

Discrete Alarms / Warnings / Notices

Bootloader running, no Appl. firmware	Alarm enabled	see Note ²⁾
Connection lost, no response from device	Alarm enabled	see Note ²⁾
RF signal loss	Alarm enabled	
Internal alarm	Alarm enabled	
Power supply (left) failure	Warning enabled	
Power supply (right) failure	Warning enabled	
Fan (left) failure	Warning enabled	
Fan (right) failure	Warning enabled	
Laser temperature high warning	Warning enabled	
Laser temperature low warning	Warning enabled	
Optical power is off	Notify enabled	
The device is starting up	Notify enabled	
Redundant device has been activated	Notify enabled	
AGC is off	Notify enabled	see Note ¹⁾
Event mask set for this device	Notify enabled	see Note ^{1) 2)}

Notes
¹⁾ This event does not produce an SNMP trap
²⁾ This event is not maskable

Change

90%

Fig. 6.7.1: Setting the event mask for the Webserver and SNMP interface

With this feature all warnings / alarms of the ES10 can be either enabled or disabled by the user in relation to the LEDs on the front panel, the Webserver status screen and SNMP interface. If the alarm/warning mask is applied a notify message will be shown on the status page (ref. to 6.1).

6.8 Properties Menu

The properties page of the ES10 provides an overview of the transmitter properties such as hardware model, hardware release, serial number and the software releases. Optionally an aliasname and some user data may be edited. The aliasname occurs in the Devices menu of all web browser displays as well as in the LCD.

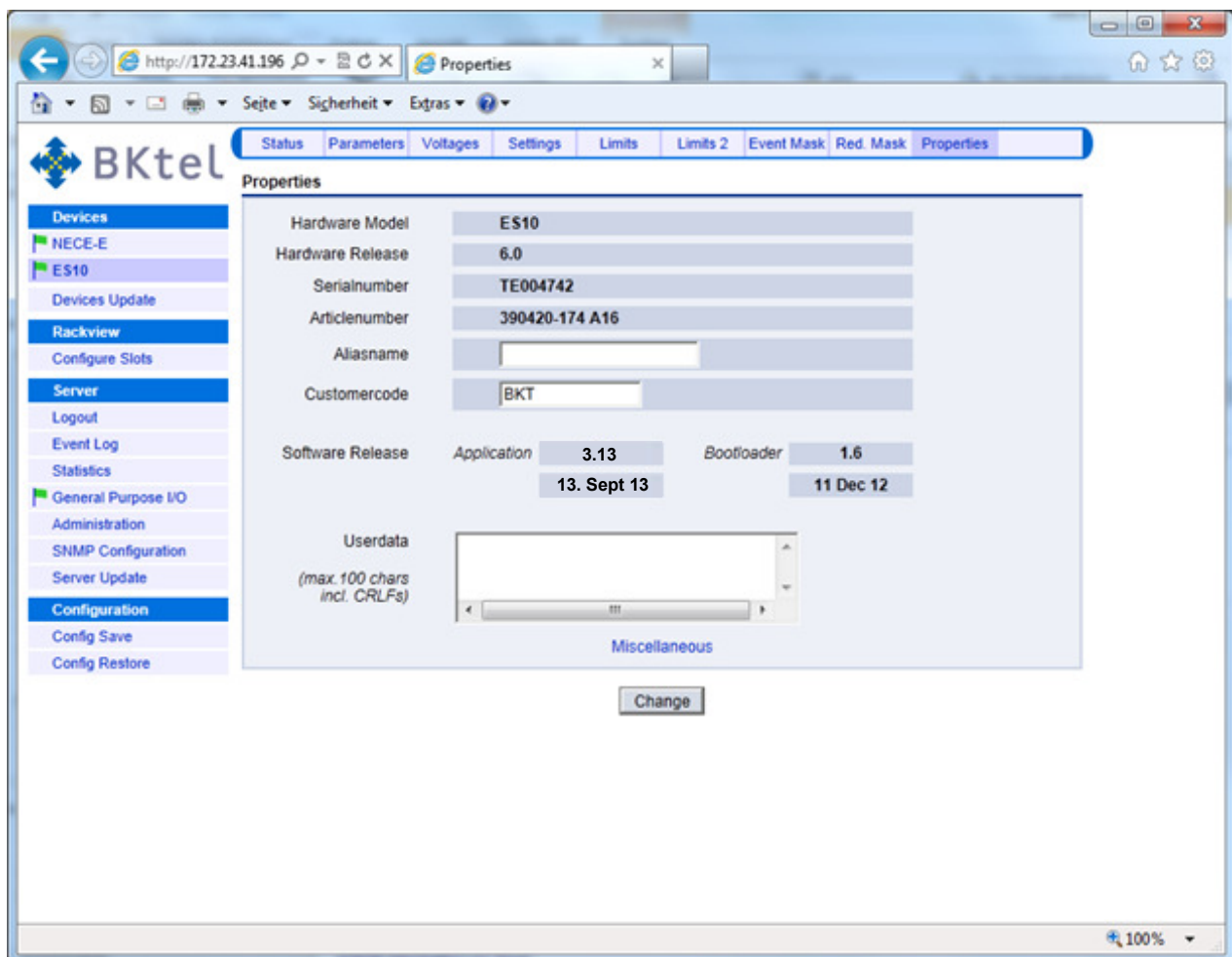


Fig. 6.8.1: Properties menu of ES10

The miscellaneous button can be used to request either a

- reset to factory settings and cold start
- reset of the transmitter (= cold start)

Note: Be very careful in executing these reset commands since they force cold start situation, where the transmitter might need about 30 seconds to get back to full performance properties.

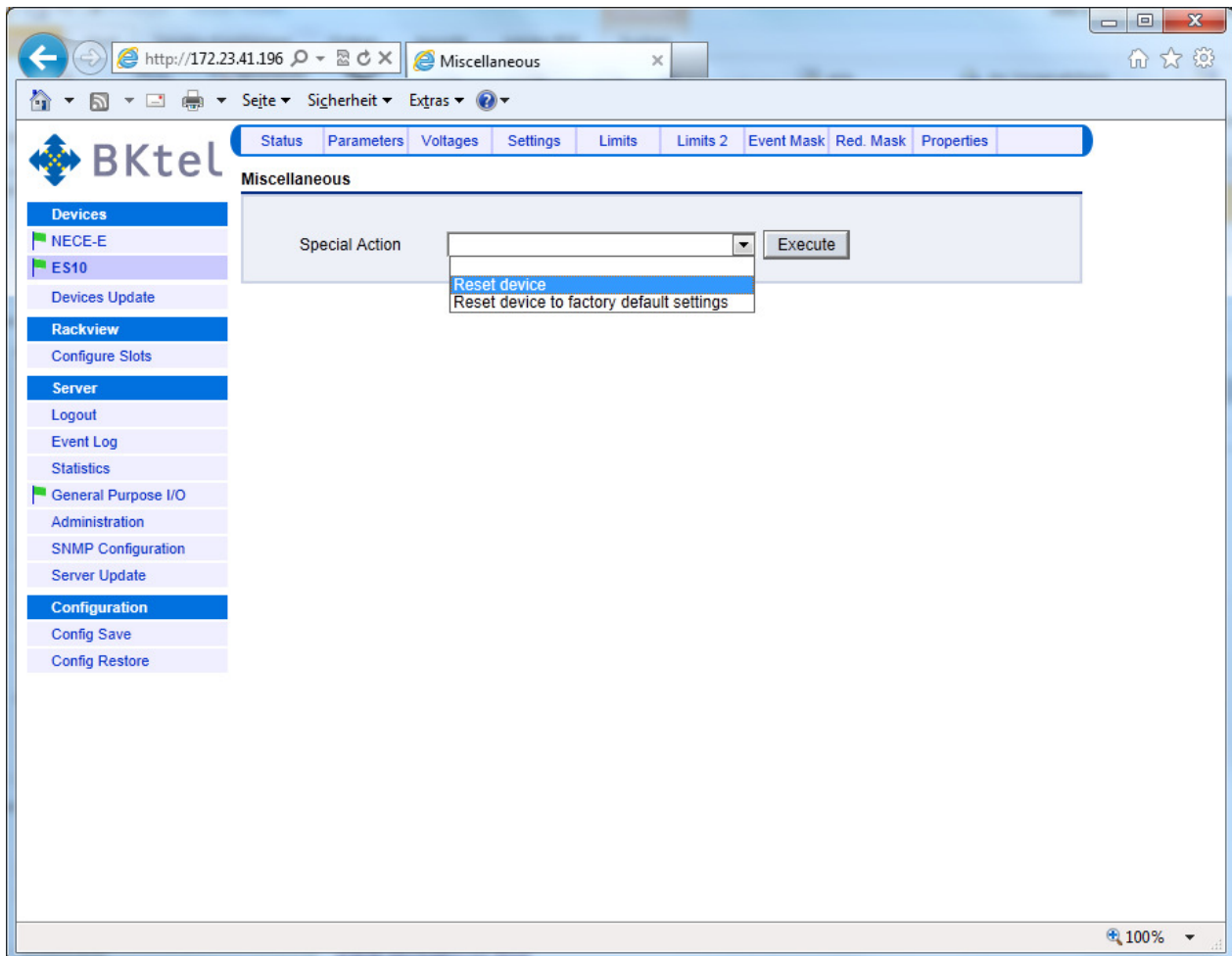


Fig. 6.8.2: Miscellaneous menu

7 CONTROLLING OTHER DEVICES WITH A NEC

One of the advanced features of the NEC is, that also additional BKtel equipment can be managed or monitored through this circuitry either

- via the push-buttons / LCD field of the ES10
- the Webserver (HTTP)
- SNMP interface.

In order to use this function, additional BKtel equipment has to be connected to the RS485 (master) interface of the NEC by using a standard RJ-45 patch cable. All BKtel subracks (BBT001 ... 003) provide two RJ-45 sockets located on the interface card on the right hand side of the subrack. Other BKtel 19"-1RU devices (EDFAs and optical switches) provide two RS485 slave interfaces on the rear side of the equipment. The two RS 485 interfaces are typically used for daisy chaining the RS485 interface bus.

There are some limitations to be considered for a proper functioning of the EMS-server:

1. Physical limitations: For the RJ-45 cable a CAT6 or better data cable is recommended. The length of the cable should be chosen as short as possible. A distance of 10 m should not be exceeded.
2. General limitations: A maximum of 48 devices can be managed by one NEC.
3. In order to get a correct display of the "rackview" function of the NEC, there are 2 more limitations required:
 - All devices to be managed by one NEC have to be positioned in one rack (and on one side of the rack if the rack is equipped with equipment from both sides).
 - A maximum of four subracks can be used. The address of all subracks have to be set correctly by adjusting the decimal switches located on the interface panel of the subracks. Address "1" has to be used for the upper subrack, the next following subrack will obtain address "2" and so on.

After powering up, the NEC will poll all equipment connected to the RS485 interface automatically. It might take up to about 2 minutes until all equipment have been identified. This is also true if equipment is removed or added during normal operation of the NEC.

8 MAINTENANCE

- Clean connector ends with a lint free tissue and alcohol before every mating.
- Loose screws fixing the optical connector plate
- Remove the connector from the connector bulkhead.
- Clean the connector ends with a lint-free tissue and alcohol.
- Reinstall the connector into the bulkhead ensuring that the cables/fibers are not stressed.
- **Caution: Do not extend the connector by more than 1 cm from the body of the ES10.**

9 TROUBLESHOOTING

To avoid problems with the ES10 and 1550 nm transmission there are some general rules which are important to follow.

- Use only carefully cleaned angled connectors like SC/APC, FC/APC, E2000 and similar ones for the whole transmission system between optical transmitter and receiver. A mix of angled and non-angled connectors will result in high insertion loss, and a degradation of the CSO and CNR performance.
- Avoid bending losses of fiber optic cables. Since optical transmission on 1550 nm is significantly more sensitive to bending losses it is very important to avoid narrow curvatures
- Use a proper leveled, flat RF-input signal. The flatness of the input signal (e.g. ± 1 dB) will directly result in the same variation of CNR, CSO and CTB (in this example: ± 1 dB).
- Be careful to understand all nonlinearities in optical fibers with 1550 nm transmission, long distances and high optical powers. CNR and CSO can easily degrade due to self phase modulation and Brillouin scattering. In doubts check the performance of the link by using an optical attenuator instead of using optical fiber to see whether the performance is limited due to impacts from the fiber.
- In case of technical questions please ask our sales representative.
- **Note: Since the transmitter is working internally with very high optical power and microwave signals it is not admitted to open the transmitter for personal safety and EMC reasons. Do not open the transmitter! In case of other than fan/power supply failures the transmitter has to be sent to BKtel for maintenance!**

10 RELEASES

10.1 ES10 Hardware Releases

10.1.1 Hardware Releases for ES10La/ES10XLa

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter
4.0	Feb 2010	New SBS Board layout
5.0	June 2011	- EMC optimized - F-connector type changed - Redesign of LED label
6.0	May 2013	supports new Flash Memory types - advanced monitoring of the RF-Signal Path - SBS Modul: Power consumption reduced, additional monitoring functions integrated

10.1.2 Hardware Releases for ES10Lb/ES10XLb

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter
4.0	Feb 2010	New SBS Board layout
5.0	June 2011	- EMC optimized - F-connector type changed - Redesign of LED label
6.0	May 2013	supports new Flash Memory types - advanced monitoring of the RF-Signal Path - SBS Modul: Power consumption reduced, additional monitoring functions integrated

10.2 ES10 Software Releases

10.2.1 Application Software Releases for ES10La/ES10XLa

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter
3.1	July 2008	- Improved LD temperature control - Improved pilot CSO control - Improved fan control
3.2	Nov 2008	Not public
3.3	Nov 2008	Not public
3.4	Nov 2008	- Improved Start-up sequence - Disabled OMI and RFin Alarm during start-up
3.5	May 2009	Not public
3.6	Aug 2009	- Protection of the cyclic laser temperature control call - Enhanced fan regulation
3.7	Feb 2010	New Firmware to support the new SBS Board
3.8	June 2011	Enhanced OMI variation range
3.12	May 2013	New firmware to support hardware changes
3.13	September 2013	Higher flexibility in supporting SBS supervising IC

10.2.2 Application Software Releases for ES10Lb/ES10XLb

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter
3.1	July 2008	- Improved LD temperature control - Improved pilot CSO control - Improved fan control
3.2	Nov 2008	Not public
3.3	Nov 2008	Not public
3.4	Nov 2008	- Improved Start-up sequence - Disabled OMI and RF _{IN} Alarm during start-up
3.5	May 2009	Not public
3.6	Aug 2009	- Protection of the cyclic laser temperature control call - Enhanced fan regulation
3.7	Feb 2010	New Firmware to support the new SBS Board
3.8	June 2011	Enhanced OMI variation range
3.12	May 2013	New firmware to support hardware changes
3.13	September 2013	Higher flexibility in supporting SBS supervising IC

10.2.3 Bootloader Software Releases

Rel.	Date	Description
1.5	June 2008	First delivered release of optical transmitter ES10
1.6	May 2013	New bootloader to support hardware changes

10.3 Network Element Controller Releases for ES10La/ES10XLa

10.3.1 Hardware Releases for Embedded NEC

Rel.	Date	Description
3.0	June 2008	First delivered release of optical transmitter
4.0	Oct 2009	New network element controller processor
5.0	June 2011	Redesign of network element controller board (EMC optimized / RS232 interface omitted)

10.3.2 NEC Application Software Releases for Embedded NEC

Rel.	Date	Description
2.4	June 2008	First delivered release of optical transmitter
2.4.2	Sep 2008	With Firefox 3 no file uploads were possible, bug in webserver fixed
3.0.0	Oct 2009	New application software version to support the new controller
3.0.1	Oct 2009	- Bugfix of alarm bell; BOT devices with faulty and not by the NECE supported alarm masks displayed a wrong "Alarmmask set" alarm bell, - LED test procedure integrated which tests the LEDs during first initialization of the software (only in production)
3.0.2	Oct 2009	- Bugfix for handling of devices, which are disconnected from the RS485 Bus and then are reconnected. - Alarm flag did not turn red in unconnected state - After reconnecting an empty event was displayed in the event log list

		The manual removal of "unconnected" devices via the "Remove" button is improved.
3.0.3	Nov 2009	- Bugfix DS55 SAT transmitter – the SAT-OMI and SAT-RF gain alarm limits could not be modified.
3.0.4	Jan 2010	- Bugfix for bootloader software update of the old Net+50 processor in the Application Software Release 3.0.x. Using 3.0.x. an error message occurred after the bootloader update. Nevertheless the new bootloader was correctly installed. The error message is removed
3.0.5	May 2010	- Bugfix SNMP "Trap Verify" Feature"; activation of the "Trap Verify" Feature" was causing a blocking of the TCP/IP stack and the LAN interface was not responding anymore. After some minutes the NECE was initiating a watchdog reset.
3.1.0	Oct 2010	Support of new devices BFE1000, BOR4085, ECE-FA
3.1.1	Jan 2011	- Bugfix BOR4160 / BOR4085 – masking of alarm and SNMP properties modified
3.1.2	Feb 2011	- Bugfix DS26 transmitter -- RF input alarm could not be modified by LCD display
3.1.3	June 2011	- Integration of USB interface
3.1.4	March 2012	- Extension of the deviation of limit ranges of input power and output power for all the "high power EDFA" based devices.
3.2.0	Feb 2013	- support of new BKtel device - support of optical receiver testpoint management (BOR4160,...) - support for external modulated transmitter expansions (ES28 support)
3.3.1	May 2013	- support of new BKtel devices

10.3.3 NEC Bootloader Software Releases for Embedded NEC

Rel.	Date	Description
1.7	June 2008	First delivered release of optical transmitter ES10
2.0	Oct 2009	New NEC bootloader to support the new controller
2.1	March 2012	Support of new flash type